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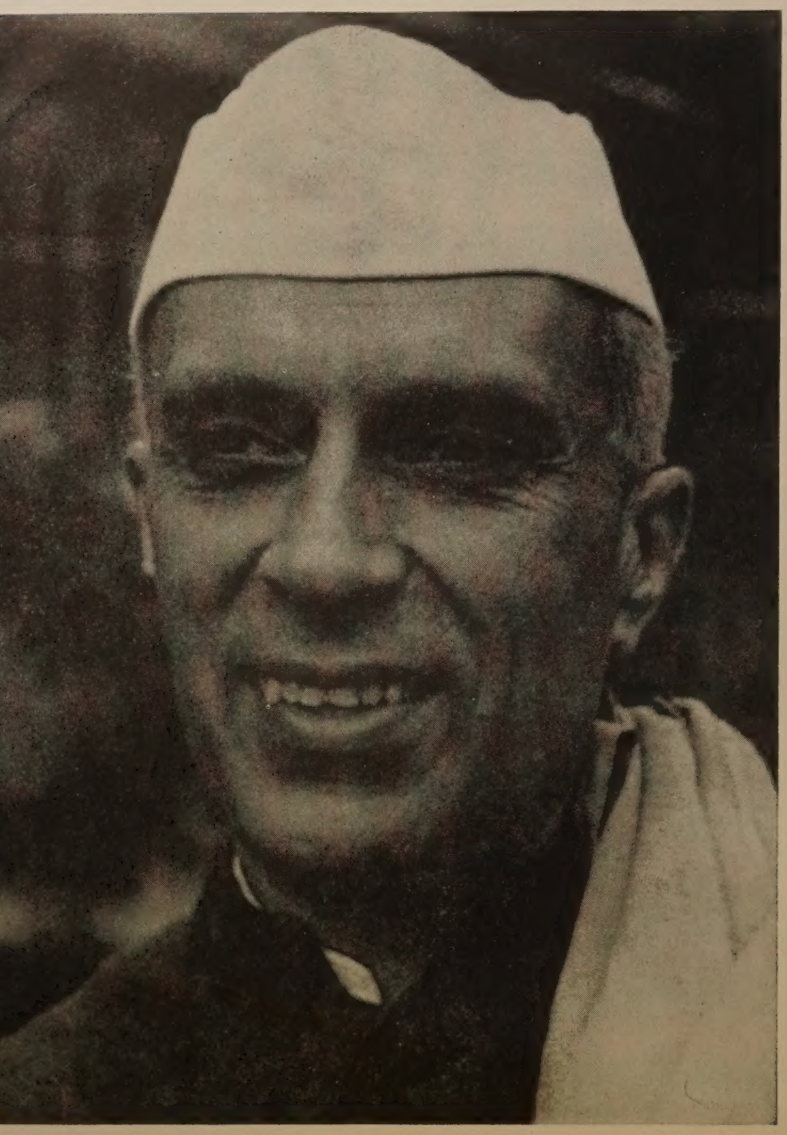
A Message from the

Prime Minister of India



"I am greatly interested in the problems of forestry and attach great importance to conservation of forests. To people in the East, as indeed in the whole world, the numerous problems of forestry hold out a great challenge. It must be met if the world is to be made a better place to live in. Fundamentally, the problems are the same in all countries, and I am sure that the coming Forestry and Timber Utilization Conference for Asia and the Far East will not only provide the means of pooling the world's knowledge and experience of forestry, but will also, by bringing together the foresters of the countries of the East, strengthen the brotherhood of forestry and the bonds of friendship which already exist among the nations participating.

"I send my best wishes for the success of the conference."

—JAWAHARLAL NEHRU
Prime Minister of India

THE first step of a practical attack on the great problems of the development of forest resources and possibilities of the woodworking industries of Asia and the Pacific must be a stock-taking of the situation and a definition of the main problems that will have to be overcome. This is the objective of the Forestry and Timber Utilization Conference for Asia and the Pacific which FAO is convening and which the Government of India has kindly agreed to hold at Mysore, starting 28 March 1949.

The Annual FAO Conference at Washington in 1948 recommended the convening of the Forestry and Timber Utilization Conference for Asia and the Pacific. This Conference will make recommendations and set up the machinery required to carry them out. In arranging the Conference FAO has at all times been in close touch with the Economic Commission of the United Nations for Asia and the Far East.

In view of this Conference, the present issue of UNASYLVA has endeavored to give a summary picture of the Forestry and Forest Products situation in the region as far as this was possible with the help of the countries concerned and of the data at FAO's disposal. The picture is obviously incomplete and perhaps the emphasis on various factors is not properly distributed—but that is the purpose of this Conference, to provide a complete and true picture on which to base future work.

Farm crops depend on uniform water supply from the forested mountains. Typical of much of Asia is this valley at the foot of the Ghats in southern India. (Photo by M. A. Huberman)

Forestry in Asia and the Pacific

Impressions During an Extended Tour of Forested Regions in Asia and the Pacific by an Officer of the Division of Forestry and Forest Products

ONE of the outstanding impressions gained from traveling through Asia and Oceania is the strong contrast between those countries with millions of people who are in critical need of lumber, fuelwood, and other forest products, and countries with large undeveloped stands of virgin timber. There is a further contrast between nations where past and continued interest on the part of government officials has resulted in building up strong forest services, research institutes, and forestry schools, and other countries where similar development must await awakened governmental interest.

Again, the contrast is very marked between countries with temporarily unsettled political situations and those where relative quiet prevails. In the former, little attention and a meager proportion of the national budget is being expended for agricultural and forestry activities, with resultant low production in logs and saw timber; in those countries where comparatively peaceful conditions exist, rapid progress is being made in increased logging and sawing, new construction in plywood and pulp and paper industries.

Outstanding features of the situation in Asia are the existence of a large fund of experience on the part of forestry technicians in the administration of public lands, in forest products and silvicultural research, in water conservation and erosion control; and the willingness of technicians to lend a hand to their fellow foresters in other countries where facilities along these lines leave much room for improvement. It was most encouraging to see the very considerable progress in repair of war-damaged cities. One of the principal factors retarding even greater progress is the lack of building materials—mainly lumber and plywood—which a little planning and capital investment could supply without too much difficulty from resources within the region.

Above all, there is great eagerness on the part of foresters and people for new ideas, for exchange of information, and for progress toward a greater degree of self-sufficiency in wood. They all want greater production and trade in lumber and other forest products.

In an atmosphere of differing degrees of experience, rates of development, and willingness on the part of technicians to co-operate, the Food and Agriculture Organization of the United Nations, working with other international organizations and with the governments of Asia and the Pacific, has an excellent opportunity through the forthcoming Conference on Forestry and Timber Utilization to help the nations

SUMMARY

	Densely concentrated population	Fuelwood shortage critical	Lumber needs great	Forest planting activity high	Potentially high timber production	Research strong	Education strong	Forestry organization strong	Forest products industrial development: High now	Forest products industrial development: High potential
Pakistan	x	x	x					x		
India	x	x	x			x	x	x		x
Burma	x				x			x	x	x
Ceylon								x		
Siam	x				x					x
China	x	x	x	x		x (in wood technology)	x			x (Manchuria)
Philippines	x				x	x	x	x	x	x
Indo-China					x	x		x		x
Malaya	x				x	x		x		x
Indonesia	x				x	x		x		x
Borneo (incl. N. Borneo, Sarawak)					x					x
New Guinea (incl. Papua and Australian New Guinea)					x					
Australia			x	x		x	x	x	x	
New Zealand				x		x	x	x	x	
Korea	x	x		x				x		
Japan	x		x	x	x	x	x	x	x	
U.S.S.R.			x							x

solve their problems. These include forest, soil, and water conservation, organization of forest services, research and education, and all phases of timber utilization and distribution. There is, especially, a great need for expanding international trade in many forest products.

These are the principal impressions of an Officer of the Division of Forestry and Forest Products on a tour of Pakistan, India, Burma, Siam, China, the Philippines, Indo-China, Malaya, Indonesia, Australia, New Zealand, and the Fiji Islands during the months of March through July 1948, assisted by previous experience in Japan.

These impressions are based on discussions with government officials of cabinet rank and at technical levels, with educators, research workers, loggers, sawmill operators, tradesmen, exporters, importers, labor union officials, and ordinary consumers. Inspections were made of logging operations, sawmills, pulp and paper mills, veneer and plywood factories, experiment stations, nurseries, forest plantations, and log and timber markets.

Status of Basic Knowledge

Summary

In summarizing the information gathered, it is most convenient to describe separately the general situations in Asia and Oceania.

Asia

Asia, for purposes of this discussion, is taken to include British North Borneo, Burma, Ceylon, China, India, Indo-China, Indonesia, Japan, Korea, Malaya, Pakistan, the Philippine Republic, Sarawak, and Siam. This region has a land area of more than 2,500 million hectares, 20 per cent of which is forested. With a population of 1,224 million people—the most populous region on earth—it has a per caput productive forest area of 0.3 hectares. In view of the rapidly increasing population in practically all of these countries, it is inevitable that this per caput area of productive forest will be seriously reduced unless vigorous remedial measures are taken.

The region is largely one of broadleaved species; less than 20 percent of the forest is coniferous; most of the productive coniferous forests are in Japan, China, India, Pakistan, and the northern Philippines. A sizable portion of the coniferous forest, as in Japan, consists of artificially reforested areas. The hardwoods are largely dipterocarps, composed of a large number of species per hectare, only a few of which are of presently known merchantable value. In this type of wood, with careful planning, exploitation can be greatly expanded. In Burma, India, Indo-China, Java, Malaya, and Siam there are important teak forests, for which sound forest-management methods have been worked out.

Large areas in almost all these countries have suffered severely from the evil effects of the "Four Horsemen" of land misuse: overcutting, roving agriculture, repeated burning, and heavy grazing. The consequences of critical soil erosion and recurrent floods are visible in much of this region, resembling the erosion in the Western Hemisphere. But, because of Asia's much heavier population pressure, the situation here is much more aggravated, and human and national lives are at stake *now!* Efforts to correct this situation have just begun in Burma, China, India, the Philippines, and parts of Indonesia, but they are hardly on a scale large enough to keep pace with the continuing destruction. Governments must become aware of the vital need for attacking this spreading disease of the land. Ceylon and Japan have, by contrast, made considerable progress in this direction.

The demand for fuelwood and charcoal is tremendous in China, India, and Pakistan, and in fact throughout the region. The need for lumber and plywood, particularly for repair of war-damaged houses, is not being met. Softwoods are the principal short item in almost all countries, and must be obtained through imports. A distinction must be made between urban and rural housing requirements. In the latter, because of tradition, low incomes, and, in some areas, the difficulty of obtaining lumber, there is widespread use of mud with only a framework of poles, as in the dry areas of India and Pakistan, or of bamboo and thatch, as in the wet regions of Burma, Indo-China, Indonesia, Malaya, the Philippines, and Siam. As industrialization progresses it is to be expected that lumber, plywood, and other wooden building materials will be needed more and more in the cities.

High-lead cable systems and former Army trucks, skid, load, and haul lauan *logs on Mindanao in the Philippines. (Photo by F. Tamesis)*

To keep pace with the phenomenal growth of Pinus radiata *in plantations, the New Zealand and the Australian Governments operate modern sawmills and preservation plants. (Photo by M. A. Huberman)*

Oceania

In Oceania, which includes Australia, Fiji Islands, Hawaii, New Caledonia, New Zealand, and other islands, there is a total land area of 855 million hectares, which is 9 percent forested. With a total population of 12 million people, this means a per caput productive forest area of 4.2 hectares. Population, at least in the case of the two largest countries, Australia and New Zealand, is increasing fairly slowly. The region is primarily one of broadleaved forests, with less than 15 percent in coniferous species. Eucalyptus forests are important in Australia; *Podocarpus, Nothofagus,* kauri, or *Agathis,* and rimu or *Dacrydium* are the principal timbers in New Zealand; and the dipterocarps are common in the various islands. The major share of coniferous stands in Australia and New Zealand is the result of large-scale afforestation programs, both governmental and private, using exotic species to a large extent.

Evidences of overgrazing and erosion are visible in Australia and New Zealand, and the effects of roving agriculture and repeated burning are to be seen in the Fiji and other islands.

Modern wood-using industries have been recently expanded in Australia and New Zealand. Government operation of sawmills and paper mills have played an important role in this development.

Owing to their climate and comparatively high income, Australia and New Zealand use wood for houses to a greater extent than the other countries of Oceania and most of the countries of Asia.

Australia is importing softwood timber, principally from New Zealand's exotic coniferous plantations, and is stepping up the harvest of its own plantations in an effort to meet the serious housing shortage.

In both Oceania and Asia there are good possibilities for expanding active trade in forest products within the region and with Europe and the Western Hemisphere. One important factor in such trade expansion is the absence of uniform grades, sizes, and drying specifications, particularly for hardwood lumber. The longer-established teak trade is better situated in this respect. Before the war there was a sizable trade in logs, as for example that in the Philippine *lauan* for veneering in Japan. There are many expressions by timber-trades people that as their aspirations are realized for building up local industries, in some cases on an integrated basis, the trade in logs will decrease, shipping space and shipping costs will be reduced, and more of the "value added by manufacture" will be kept at home.

Resources Survey

In an effort to determine the extent of their forest resources, a number of countries are assembling aerial photographs taken during the war and seeking to develop ground-survey methods that will utilize these photographs. New Zealand is making excellent progress in this direction and considerable work is being done in Australia, Burma, Indonesia, and the Philippines. Countries such as Burma, India, Indo-China, and Malaya have rather detailed records of standing timber, volumes and growth rates for those parts of the state forest land already under management. Information on new areas not yet subject to exploitation is in most cases based only on rough estimates. There is consequently a great need for the inauguration or enlargement of modern forest-survey programs to utilize the latest techniques in combining aerial photographs with ground surveys. The experience of the New Zealand and other forestry services should be of considerable help to neighboring countries.

Industries

Knowledge of the number, size, and production of sawmills and other wood-using plants in the several countries is, with few exceptions, unfortunately rather sketchy. In a few countries there is a complete record of each mill, its location, its raw-material resource, and its annual production, required by a permit or licensing system. The other extreme exists in most countries, which have no record whatever of

such installations. Where mills depend entirely or in large part on government-owned forest land there are usually fairly complete records, but where they work on privately owned timber this is not the case. In countries where plans and blueprints have been made or are being translated into actual construction and operation of pulp and paper mills, sawmills, veneer and plywood plants (as in Australia, India, and New Zealand and to some extent in Indo-China), advantage is being taken of the latest developments in machinery and technical processes. For the most part, however—and this is probably more true of long-established mills and logging operations—there is much room for modernization and increased efficiency.

Statistics

With the growing realization of the tremendous unsatisfied demand for all forms of wood products, many governments are strengthening their statistical agencies in order to obtain information on forest resources as a basis for planning new developments in forest industries. Data as to requirements, consumption, production, and distribution are also quite necessary for intelligent planning of export and import trade.

Forest Management

On the basis of past experience and research, the fund of knowledge about the management of the numerous forest types varies considerably from country to country. The India Forest Service has a fine heritage of scientific work in the handling of *sal, Shorea* sp., and *chir* pine, *Pinus longifolia,* forests.

Beginnings have been made in Indo-China, Malaya, and the Philippines in the development of silvicultural methods for the dipterocarp forests, but much more needs to be done, especially in the undeveloped stands of Borneo, New Guinea, and parts of Indo-China, Malaya and Siam. Reforestation methods have been developed over a long period in China. Silvicultural treatment for coniferous plantations has been or is being developed in Australia, Japan, and New Zealand. Further work is needed in the best ways of handling the eucalyptus forests of Australia and the indigenous *Nothofagus* and mixed conifer types in New Zealand, to assure natural regeneration, to increase growth rates, and to move toward sustained yields.

The Burma Forest Service and the Dutch foresters in Java have developed highly satisfactory systems of teak forest management. The preparation of charcoal is often combined with clearing of low-value forest for conversion into pure teak plantations. When the timber has been cleared, teak seeds are sown, sometimes with other species, and farm crops are cultivated between the rows of trees for several years. In Java the system has been worked out so that yields are obtained from early thinnings long before the remaining trees are mature for high-value lumber. Old trees ready to harvest are girdled two or three years before cutting; they dry out and can then be floated in streams or more easily hauled on land. In parts of Java the logs are hewn into railroad ties or squares, which are later whipsawed into boards. To please fastidious buyers in Java, some teak logs are hewn into perfect cylinders, thereby wasting considerable wood, which is left as chips in the forest. Such material, if slabbed at a sawmill, could be used to make short cuts for furniture. Fortunately, this practice is dying out. The demand for teak from Burma, Java, and Siam is extremely high, and the resumption of prewar trade with foreign markets is to be expected.

Information as to growth rates and yields is incomplete for most forest types in nearly all countries. There are exceptions in Burma and India, but foresters in every country are keen to expand their work in this important phase of forest management.

Technical Properties of Species

Good progress has been made in testing the wood of most dipterocarp species in the Philippines and of the eucalypts in Australia. Some knowledge is available from prewar work at Dehra Dun, India; Kuala Lumpur, Malaya; Buitenzorg, Java; and at the Meguro Experiment Station, Japan. A joint approach to this problem could be highly profitable to all countries.

Government Interest and Action

The interest of government officials has been translated in varying degrees into policy, legislation, government organization, and budgets.

Policy and Legislation

The Indian Forest Act, dating back to 1878, originally promulgated by Sir Dietrich Brandis and built upon by other stalwarts of forestry in Asia, is still the basis for the forest services of Burma, India, and Pakistan. Other countries have somewhat less detailed and less complete policies or legislation, but the functions of their government forest services depend upon the current interest of high government officials, as in China, the Philippines, and Siam. Under the general direction of their metropolitan governments, local forest administrators in Fiji, Indo-China, Indonesia, and Malaya have drawn up rules and regulations to govern the administration of pub-

Silvicultural measures developed in Indo-China have succeeded in naturally regenerating Dipterocarpus dyeri *in Cambodia. (Photo by Direction des Eaux et Forêts de l'Indo-Chine)*

Roving agriculture has left its mark on much of Asia's undeveloped forest areas, as shown here in the Dalat region of southern Indo-China. (Photo by Direction des Eaux et Forêts de l'Indo-Chine)

lic forest land. In Australia the individual states have their own forest legislation, which is now in process of being gradually co-ordinated with Commonwealth policy. In New Zealand the numerous fragmentary forest acts are being reconsidered for possible consolidation into one clearly stated policy.

With the achievement of varying degrees of independence, the nations involved need to re-examine their forest policies from the viewpoint of their own people's requirements with regard to greater local manufacture, raising domestic consumption levels, more careful attention to watershed protection, and development of unexploited forest areas.

Organization

The administration of state forest land has been handled by well-developed forest services in what is now Pakistan, in India, and in Burma. These services are now almost entirely in the hands of the foresters of the respective countries, with only nominal temporary guidance from former European members. Foresters who had been in subordinate grades have been moved up into responsible positions and are eager to demonstrate their ability to carry on the work of the services they inherited. The organization in Malaya consists of European foresters in the top supervisory positions, with Malayan foresters working under them. In varying degrees, the services in Indo-China and Indonesia are being reorganized so as to include more local foresters, with a decreasing number of European foresters as advisors. In the Philippines, the number of American foresters, which never was very large, had been consistently reduced until, with the achievement of independence in 1946, the service was entirely made up of Filipino foresters.

In Australia each state has its autonomous organization under a state forestry commission. Its work is subject to voluntary co-ordination with the policy of the newly organized Commonwealth Bureau of Forestry. In New Zealand there is one strongly organized state forest service for the entire country. China has in part carried out plans for strengthening its national forestry bureaus, but still depends upon the interest of individual provincial governors. Further development along this line must await the settlement of political and economic difficulties.

Siam is studying the report of the FAO Mission before taking up the reorganization of its forest service, which at one time was a very active organization.

Research

There are some outstanding research institutions in the region. The Forest Research Institute at Dehra Dun, India, has for many years carried on dendrological, silvicultural, and forest-products investigations. With the current reorganization, including the replacement of all European personnel by Indian technicians, greater emphasis is to be placed on applied research, especially on forest products. The Institute has an excellent herbarium, photograph collection, museum, and records of silvicultural experiments. It is willing to make its facilities available to technicians from neighboring countries.

The excellent equipment of the forest products laboratory of the Council of Scientific and Industrial Research at Melbourne, Australia, is already being used by visiting technicians from other countries, and the staff wants to enlarge this type of co-operation. Good facilities have been restored since the war at Buitenzorg, Java and at Kuala Lampur, Malaya. Efforts are being made to increase the small staffs and the administrators are willing to invite technicians from other countries. The war badly damaged the research facilities at Saigon, Indo-China; at Los Baños, Philippines; and at Meguro, Tokyo, and other places in Japan. These are being slowly rebuilt, but many of the valuable experimental records unfortunately cannot be replaced.

Forest research in China, under the National Forestry Research Bureau, is actively conducted at two large stations in Chungking and Peiping, principally in the field of seed, nursery, and planting problems, and on a more diversified scale at the headquarters laboratory near Nanking. Additional research, principally in reforestation, is carried on by ten universities and several memorial park foundations in China. Plans have been drawn for comprehensive research programs.

New Zealand's comprehensive program in silviculture and forest products awaits the settlement of budget and personnel questions. Research in Siam is as yet undeveloped. In the past, research in what is now Pakistan and Burma was done largely at Dehra Dun, India. The development of independent research in these two countries has not yet been decided upon.

Excellent work is being done at a number of botanical gardens, among them those at Buitenzorg and Singapore, at Sun Yat-sen University and Nanking University in China, and at the imperial universities in Japan.

Education

The training of forestry technicians is an essential step in improving the standards and enlarging the scale of forestry work throughout Asia. With the inevitably growing appreciation of forest conservation, and improving forest utilization, the need for well-trained technicians will become more and more apparent. There is a continuing increase in the enrollment of forestry students in many countries. It is heartening to report the current operation of well-equipped schools for professional training at Dehra Dun, India, at 10 universities in China, at the University of the Philippines, at Los Baños, and at Canberra, Australia. All of these schools have accepted and are willing to accept forestry students from neighboring countries. There is also a forestry school at Creswick, Victoria, in connection with the University of Melbourne.

There are schools for training ranger and guard personnel at Dehra Dun and Coimbatore, India; Murree, Pakistan; Pyinmana, Burma, with the possibility of enlarging the school to professional status at the University of Rangoon; at Prae, Siam, with the possibility of having a professional school set up in the Agriculture College at Bangkok. There is one vernacular school at Kuala Lumpur for guard personnel of the government service. There is a guard school at Pnompenh, Indo-China, and plans exist for granting scholarships to local foresters to attend the school at Nancy, France. There is a program under way to initiate 5 ranger-type schools in Indonesia, one of which would be in Borneo. The forestry education system of New Zealand is being completely reorganized; the proposal being given most serious consideration is that of having undergraduate work

Long the romantic symbol of logging in India, Burma, Siam, and other countries in Asia, the elephant continues his role as an outstanding jungle worker. (Photo by M. A. Huberman)

provided in science at the four universities, with graduate work in forestry supplied by the training and research staff of the State Forest Service at Rotorua.

Forestry Publications

An important medium for the exchange of information among administrative, research, and industrial foresters is through the publications of professional forestry societies and government forestry services. There were a number of such publications in Asia and the Far East before the war; some were interrupted during the war, but most have been resumed, and there is a possibility of new journals being issued.

Those now being published in English include *The Indian Forester, The Malayan Forester, The Philippine Journal of Forestry,* the *Australian Forestry Journal,* and the *New Zealand Journal of Forestry. The Empire Forestry Review,* of course, has carried considerable material on Asia and will undoubtedly continue to do so. *Tectona,* covering forestry work in Indonesia, is published in Dutch with some English summaries. Chinese and Japanese publications have not yet resumed publciation since the war. Publications in Burma, Pakistan and Siam are in the planning stage.

Obviously the maximum benefit of information exchange would accrue if all journals were published in one language. This may not be practicable, but it is to be hoped that at least summaries of all articles will be given in that language which is most widely understood in most countries of Asia and the Pacific. Furthermore, exchange of publications between countries ought to be arranged as soon as possible, to make sure that libraries of forestry schools, research stations, government and industrial organizations receive all such journals.

Private Initiative

Logging

Logging operations for the most part are carried on by private enterprise as timber concessions on state forest land. In Burma, the large private teak companies are being nationalized. The governments of Australia and New Zealand also carry on logging operations on public land.

As for logging methods, in Burma, India, and Siam well-trained elephants are an important source of power; considerable effort is put into trapping and training these animals. In parts of Indo-China, Java, and the Philippines, buffaloes are used in logging. However, there is a growing tendency to replace animals with power machinery. This is especially true in the Philippines, where United States Army tractors, bulldozers, logging arches, and other equipment left over from the war are being used on a large scale. More such equipment will be used as the problems of monetary exchange are solved.

Sawmills

Sawmill operations in Asia still use slow, worn-out machinery in most places. Production per man-hour with such equipment tends to be very low, but traditional usage and the difficulties of foreign exchange retard the adoption of modern sawmill machinery. A more important factor, which tends to encourage the use of faster new machinery, is the current change in wage rates for mill labor. The traditionally cheap labor of Asia is gradually demanding higher wages, which will only be justified if production per man-day increases.

In the Philippines many U. S. Army sawmills are being worked full-time to produce an increasing amount of lumber for export. The more progressive operators are seeking to buy modern equipment to replace these sawmills as they wear out. Most mills are powered by steam, but in many places diesel and electric motors are replacing them. There is considerable room for installation of more dry kilns and preservative-treating plants. The demand for lumber is so great, of course, that most operators do not feel justified in spending the money or taking the time to season or treat lumber. However, some of the more progressive operators see the advantage of selling well-dried lumber.

Hand-logging methods are used in Malaya, Indo-China, Japan, and elsewhere. Sleds pushed over greased cross-ties are used in Kyushu, Japan. (Photo by M. A. Huberman)

Veneer, Plywood, and Fiberboard Plants

There are only a few veneer and plywood plants in most of these countries, despite the great potential market for such products. The housing shortage is critical in many countries and could be alleviated if more plywood were available. There is considerable talk and some planning, especially in India and the Philippines, for the development of such an industry. Australia and New Zealand are increasing their production of plywood as one means of meeting their housing demand.

There is considerable interest in fiberboard and wallboard plants in New Zealand and Australia, which already have a few such installations. The potential market for this material is quite important, but throughout a large part of Asia the use of woven bamboo for wall panels will, because of tradition and low income, withstand the competition of higher-priced lumber, plywood, and fiberboard.

Fuel

Perhaps the most extensive use of wood in this entire region is for cooking and heating, in the form of fuelwood or charcoal. In many countries, and especially in China, firewood is weighed on scales and the price is so high that few families can afford to buy more than a very small bundle—a handful of sticks—at a time. In Pakistan and India fuelwood and charcoal are scarce and cooking is done with dried animal dung. There is considerable activity throughout Asia in collecting and trading fuelwood and charcoal; many small sampans and barges can be seen loaded down with such products moving between the islands and along the coasts. In many parts of China, young plantations are destroyed long before they are ready for cutting to supply critically needed fuelwood. There are many instances of pruning side branches to stimulate new branch growth for fuelwood production like a pollarding or coppice-in-the-air system. Unless some alternative fuel is provided for a period long enough to allow the plantations to reach large sizes, there is little hope of solving this critical problem in countries of high and increasing populations.

Trade

Many of the countries are seeking to build up export trade and are faced with the problem of reconciling their own domestic needs for reconstruction with the high-priced export market, which would bring in much-desired dollars and pounds. The Philippines are trying to build up an export trade with the United States; New Zealand is bending its efforts toward foreign markets for exotic pine lumber, most of which now goes to Australia. Southwestern India wants to resume trade with the Near East, but regulations require the major proportion of production to be sold on the domestic market.

One serious difficulty in fostering import and export trade lies in fluctuating currencies. Still another difficulty is shipping space, and, in the case of Australia and New Zealand, a question of loading and unloading available ships.

To meet the demands of certain high-priced markets it is necessary to have available large quantities of dry lumber. The scarcity of dry kilns in many countries is a retarding factor, but one that can be overcome without serious difficulty.

Timber trade among Asiatic countries, and especially between them and the countries of Europe and the Western Hemisphere, would be simplified and greatly stimulated if buyers, producers, and sellers would agree to uniform grades and specifications. Efforts in this direction are being made in Singapore, in the Philippines, in Australia and New Zealand. These efforts need to be co-ordinated so a system of grades and sizes can be accepted generally.

High standards of housing by Government and private industry attract workers to logging and sawmilling in Australia and New Zealand. (Photo by M. A. Huberman)

Trade Associations and Labor Organizations

There is considerable organization among sawmill owners, exporters, and importers in certain parts of the region. This is especially noteworthy in the Philippines, in Australia, in New Zealand, and to some extent in India and Burma. These associations are in an excellent position to promote the development and acceptance of uniform grades and sizes. Many of them are already interested in such an undertaking.

At the same time, organization of labor is spreading, especially in Australia and New Zealand, and more recently in Malaya and the Philippines. In Australia and New Zealand, labor unions have played an important part in obtaining improved housing facilities for both single and married men on logging operations and in sawmill towns. With housing as the key to the manpower shortage, the success of the unions in this direction has resulted in a more suitable working force in the wood-using industries than in other industries. As labor organization increases there will undoubtedly be a tendency towards higher wages, which in turn will require higher production per man-day. This should mean the more general adoption of modern machinery in all parts of the wood-using industry.

Conclusion

In view of the problems facing the region it is obvious that no one country can solve all its difficulties alone. Many problems are common to a number of countries. With this in mind, the member governments of FAO at the 1948 Washington Conference requested the Director-General to call a Forestry and Timber Utilization Conference in Asia early in 1949. This idea has been also endorsed by the Economic Commission for Asia and the Far East at several of its meetings. Above all, it is to be hoped that the conference will arouse sufficient interest to stimulate governments to build up their forest services and thereby improve the standards of living within their countries.

Hand-sawing of deodar *cedar railway sleepers in a hill forest. The forests are remote and sawing has to be done at site. The sleepers are carried by men to the nearest stream and floated to the depots.*

Utilization of the Forest Wealth of India

By B. R. SEN

THE time has come to revise the entire outlook on the utilization of forests in India. Past policy, though based on essentially sound principles, appears to have been rather static. Now it must be more dynamic. The existing forest policy was laid down in 1894, with these main principles: (a) the need to prevent floods, soil erosion, and desiccation must be the first consideration in forest management; (b) preservation of the minimum amount of forests necessary to satisfy the wants of the local population for fuel and building must come next; (c) exploitation of forest resources for commercial purposes is permissible only after these needs are adequately satisfied.

The essential soundness of this policy will hardly be challenged. The question arises whether, under the new conditions in India, the administration of that policy needs any change. To deal with this question, certain essential facts about Indian forests must be taken into account.

In the interest of the country as a whole, what proportion of a country ought to be forest land? Various opinions have been expressed. Sir Herbert Howard, late Inspector-General of Forests, expressed the view that 20 to 25 percent of the land in India ought to be covered with forests, properly managed and distributed for protective purposes and to supply consumers all over the country. Of a total area of 162 million hectares in India, about 40 million hectares, or about 25 percent, are estimated to be forest land.

At first sight it might appear that the present area of forests in India should be adequate for its needs. But about one-third of this area is under communal or private ownership, which, as in other countries, has been extremely wasteful. Within the definition of properly managed forests, only about 11 percent of the total land area is of the reserved and protected types of forest.

The present distribution of forests is far from satisfactory from the point of view of meeting the needs of village consumers. The provinces north of a line from the Gulf of Cambay to Calcutta are particularly deficient in forests, except in patches.

Soil Erosion and Forests

Floods and soil erosion are two of India's greatest problems. Neither is new, but there can be no doubt that in recent years floods are taking an increasing toll of crops and the rapid progress of soil erosion in different parts of the country has caused grave concern. These problems are intimately connected with the management of forests in the hilly country and at the headwaters of rivers.

A large portion of India's forest is under government management, but considerable areas are under private ownership, which, during the last few decades, has recklessly exploited them for grazing or fuel, exposing considerable areas to the danger of floods and soil erosion.

The matter has now the fullest attention of the Government of India. Proper land management will be an important subject for study by the Central Waterways, Irrigation and Navigation Commission, which is already functioning, and by the Land Utilisation and Soil Conservation Board, which is proposed. Forests, however, are a provincial subject and unless there is full and active co-operation from the provincial governments, success in this field must be limited.

So far as village consumers are concerned, while the policy of making the supply of fuel and timber to them as second in importance only to the control of floods and erosion is unexceptionable, the application of that policy does not appear to have yielded satisfactory results. Nine-tenths of the United Provinces, half of Bombay, most of West Bengal, much of Bihar, and the whole of coastal Orissa are almost completely without forests. The small quantities of fuel and timber required by the villagers in these areas cannot be transported long distances and still be within their purchasing power.

The villagers have been compelled to use one of their most valuable agricultural assets for fuel, and this has seriously affected food production. Agricultural crops depend very largely on the supply of manure. India's soils are particularly deficient in nitrogen, needing about 2½ million tons annually to replace that used by crops. In the past India has largely depended on cowdung to supply the nitrogen deficiency. The total production of cattle manure in India is estimated at 160 million tons of dry weight, or 800,000 tons of nitrogen. Actually, however, 40 percent is used as fuel and about 320,000 tons of nitrogen, which could produce an additional 1.75 million tons of rice, is lost. This manure can be saved only if the rural population is provided with fuel from quick-growing trees where there are no natural forests to draw upon.

This question has been discussed both by the central government and by the Provinces, but, owing to the lack of a determined policy, little has been done. The establishment and implementation of such a policy remains one of India's most urgent and important problems.

Forestry and Industry

Under the policy laid down in 1894, the uses of forests in India have been confined very largely to supply railway sleepers, furniture, and house-building materials. The bulk of the valuable hardwoods is reserved for railway sleepers but the supply is inadequate and sleepers of timber and steel are imported. For household purposes large imports of teak

Every year many millions of bamboos are cut in India and used for making paper, baskets, scaffolding, fences, etc. Twenty-five to thirty bamboos are cut from each clump once every four years, those left being carefully spaced.

come from Burma. Indian forests have scattered hardwood trees, which makes economic exploitation difficult. Consumers are reluctant to use any timber other than that belonging to the primary species.

India has great plans for industrial expansion based on the use of structural steel, which is in short supply. Can treated timber replace structural steel to any extent? Experience has shown that it can in the construction of highway bridges to a certain extent, and it can be used for telegraph and telephone poles, roof trusses for factories, godowns, workshops, and airplane hangars.

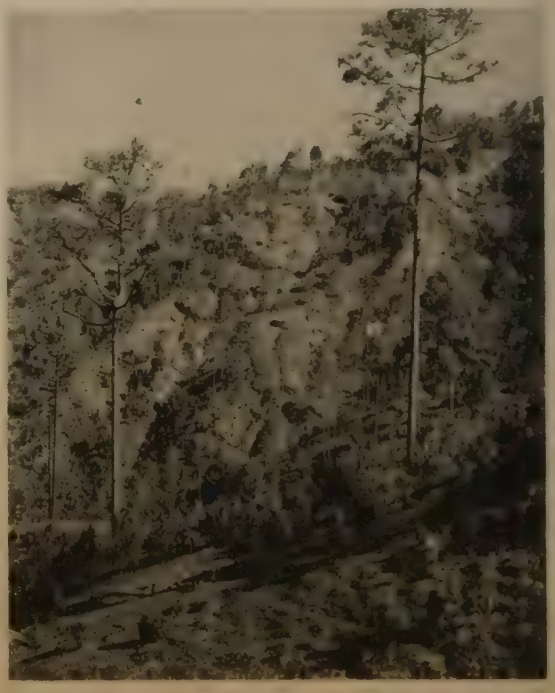
The cheapest steel in the world is produced in Belgium, yet Belgium finds it more economical to use treated timber for telegraph and telephone poles. In the United Kingdom more than 90 percent of the poles for telegraph and telephone lines are made of timber from Scandinavia. In the United States up to 80 percent of the bridges on most of the leading railways—which use much heavier locomotives than in India—have till recent years been built of treated wood.

If such highly industrialized countries can find these uses for treated timber, why should India not try to do the same, especially when its industrial progress is held up for lack of steel? The major consuming departments of the Government of India indicate that the main obstacles to greater utilization of Indian timber have been the lack of properly treated timber at centers convenient to transportation. This problem is surely not beyond administrative solution. It is being examined by the Government of India.

There are other industries in which Indian timber can play a more positive and effective part. Plywood, for instance, can be one of the most important timber industries in India. The annual requirements amount to 1⅓ million square meters. Large quantities of plywood used for packing Indian tea for export are now imported. With a little more enterprise in research and organization and a little more co-operation from the tea industry, it should be possible for India to supply all demands from within the country.

India needs an estimated 6,200,000 railway sleepers a year. The present production from Indian sources amounts only to 3,000,000, less than half of the requirement. The Forest Institute has suggested 36 species of secondary timber that can be used for sleepers. It is hoped that the railways will find it possible to eliminate their demand for steel sleepers and make the utmost use of the available species, even though they may not be as satisfactory as the best hardwoods.

The jute and cotton mills require 80 million bobbins annually. Before the war almost the entire demand was met from outside. During the war, Indian industry was able to meet the entire demand. Imports have started again with the end of the war. It is clear, however, that if Indian industry is properly organized and arranges for a supply of timber, India can be self-supporting in the supply of bobbins.



A seeding felling has been done in a chir *pine forest,* Pinus longifolia. *The mature trees have been cut, leaving about seven seedbearers to the acre. The young plants have come up in patches.*

Newsprint Production

The present annual demand for newsprint is 50,000 metric tons, all of which is imported from hard-currency countries. Valuable research has been carried out, and paper produced from paper mulberry, *Broussonetia papyifera*, has been tested with very satisfactory results. If plantations of this fast-growing tree are made in earnest there is no reason why, within a reasonable time, India should not be able to supply and to keep pace with its growing need for newsprint.

There are other industries in which forestry can play an important part. While the prevention of floods and soil erosion and satisfaction of the fuel and timber needs of the local village consumers must continue to receive priority, the use of forest resources for industrial development must also be given a prominent place in future programs of forest [illegible] opment. The success of this policy will, however, [illegible] pend on certain definite factors. Research activities must be extended and intensified to meet all [illegible]hnical needs and problems.

The prejudice of important industrial consumers against the use of the secondary species must be overcome. And, most important of all, felling, regeneration, and plantation practices must be revised to the extent necessary to cope with the growing volume of demand.

It will also be necessary to devise much more effective arrangements than in the past to publicize the uses of forest products for industrial and commercial purposes, in the light of the latest research. Toward the success of this policy, quite apart from the Government, industrial leaders can play a decisive part

Photographs accompanying this article were furnished by the Forest Research Institute, Dehra Dun, India.

Forestry in China

By SHUN-CHING LEE and NGAN HAN

THROUGHOUT the history of China there have been settled periods during the life of a dynasty, followed by political change and the succession of a new dynasty. During the settled periods there was usually a realization of the importance of forestry. During periods of strife and change, forests were destroyed.

China, at one time, was quite heavily forested, but most people knew little of the value of trees. As the population increased, the forest area diminished.

In the early part of the Chow Dynasty,[1] which began in 1122 B.C. and lasted until 255 B.C. the central government of China established a Forest Service with the dual objective of preserving the virgin forests and reforesting denuded lands. There was strict management of state forests and officials were appointed to help supervise the management of private and communal forests. This dynasty ruled during one of the most outstanding periods of Chinese civilization, but many of its records were lost during the Chin Dynasty (255-206 B.C.), when the emperor ordered many of the books burned. He was interested in trees, however, and preserved the books on forestry from destruction. During his reign he built many highways along which he planted trees.

In the Han Dynasty (208 B.C. - 220 A.D.) the government encouraged the people to plant economic food and timber trees. Contacts were being made with western countries, and China introduced several foreign plants, among them Persian walnut, *Juglans regia*, and alfalfa, *Medicago sativa*, both of which have become completely naturalized. Horses were introduced, along with alfalfa.

During this time China was mainly under one government but was later divided into North and South. Population had increased, rival factions warred against one another, nomads from the Northwest roamed through China with their cattle, destroying the forests wherever they went.

During the Tang Dynasty (220-265 A.D.) there was renewed interest in reforestation of denuded areas. More new plants were introduced, including the olive and the almond from Arabia, both of which still carry the Arabic names. Tea was planted for the first time.

Forest extension work was at its height in the Sung Dynasty (420-589) when each *hsien* (district) had its director of agriculture and forestry directing the people in census-taking, forest management, and farming practices. The policy was to let neither people nor land be idle. Public lands that a farmer reforested became his own. Direct planting of seeds for reforestation was widely adopted and proved quite successful. Monographs were written on plants including the tung tree, *Aleurites* spp.; *Paulownia* sp.; *Citrus* sp.; and bamboos, *Phyllostachya*, *Bambusa*, and others, giving their descriptions, how to grow them, and how to control disease and insect attack.

The capital was at Nanking during the Ming Dynasty (1368-1644). Four experimental stations were established just south of Purple Mountain to improve the production of tung oil (from nuts of *Aleurites* spp.), varnish (from the bark of *Rhus* spp.), rope (from a species of palm), and alfalfa forage. These products were in demand for military use and for building.

The Ch'ing Dynasty (1583-1912) followed, and after it the Republic whose founder, Dr. Sun Yat-sen, renewed emphasis on forestry. Forestry suffered during the revolution and the Japanese occupation, but increasing attention was paid after World War II to soil conservation, flood control, and reforestation.

Forest Conditions

Forest Area and Timber Volume. The aggregate area in China that is at present actually under forest cover is estimated to be somewhere around 83 million hectares, about 8.5 percent of the total land area of the country. Virgin forest covers some 29 million hectares and secondary forest covers some 54 million hectares. Timber volume for each amounts to approximately 5 thousand million and 3 thousand million m^3 respectively. Denuded mountain and waste lands suitable for reforestation purposes cover some additional 300 million hectares.

A raft of Chinese fir, Cunninghamia lanceolata, *in Chekiang Province.*

[1] *History of Forestry in China and Its Administration during the Republic*, by Chen Yung, Forestry Department, University of Nanking, 1934 (in Chinese).

Pressure of people on the land has forced the unwise clearing of hill forests for crops; oats on last year's clearing on the left. Shansi Province.

Forest Ownership. As to forest ownership, no exact information is yet available. It can be only roughly estimated that about 90 percent of the virgin forest and 5 percent of the secondary forests are in public ownership, and the remaining 10 percent of the virgin forest and 95 percent of the secondary forest are in private and communal ownership.

Principal Timber Trees and Their Distribution. Because of the mountainous character of the land, its wide range of climate, and copious rainfall, China is extremely rich in arborescent flora. Years of investigations by the Chinese Botanical Society have shown 134 families, more than 656 genera, and over 2,000 species. It is said that a greater number of tree species is found in China than in all of the other north temperate countries. Nearly every important genus of coniferous and broadleaf tree known to the temperate regions of the Northern Hemisphere is represented in China. Commonly known trees generally used for plantations in the various parts of the country are:

Cunninghamia lanceolata generally grows in the area extending from the Yangtze River southward to the Nanling Range at elevations not exceeding 1,000 meters.

Pinus massonia grows throughout central and southern China at altitudes not exceeding 1,000 meters.

Picea asperata is widely distributed, hardy, and vigorous. It reaches southward to northern Szechuan and eastward through Shensi and Shansi to Hopeh, occurring from 2,500 meters' altitude up to the timber line.

Abies delavaya occurs in Manchuria, Outer Mongolia, and northern Szechuan between altitudes of 2,500 and 3,500 meters, usually forming extensive pure stands.

Tsuga chinensis occurs in Shensi, Kansu, eastern Sikang, Szechuan, Hupeh, Anhwei, and Chekiang, growing at altitudes between 2,800 and 3,500 meters.

Larix potaninii is most abundant in the Yelukiang forest district. It also forms vast pure stands in Szechuan and Shensi at altitudes between 3,000 and 4,500 meters.

Pinus tabulaeformis is widely distributed in north to central and western China, at altitudes not exceeding 1,500 meters.

Thuja orientalis is widely cultivated all over China for ornamental and building purposes.

Quercus acutissima and *Q. dentata* are frequently found in central and northern China at altitudes between 1,000 and 2,000 meters.

Bamboos flourish in all of the southern provinces and along the Yangtze valley up to an altitude of about 1,000 meters. They are put to many uses for food, for building houses, bridges, rafts, for the manufacture of paper, furniture, umbrellas, musical instruments, and all kinds of farm implements and household utensils.

Aleurites fordii and *A. montana*, the tung oil tree, are widely distributed in China south of the Chingling Range, principally in the provinces of Szechuan, Kwangsi, Hunan, Hupeh, Kweichow, and Chekiang. They produce seeds from which tung oil is extracted. Ninety percent of the total amount of tung oil is produced by *A. fordii*.

Forest Policy

It is estimated that more than 80 percent of the people of China are farmers. The situation of the Chinese farmer, however, may be unique in that he usually has less than one-fifth hectare of cultivable land. He plants whatever is most productive in terms of money and crops to support himself and his family. The emphasis for him must be on annual turnover or he and those dependent upon him will starve. If he can spare a little land he may grow trees on it but only if this does not interfere with the grazing of his water buffalo or take too much time from working his other crops; and provided it can be proved to him that trees will benefit him and his family. However, there are large amounts of "public land" upon which the people graze their livestock and gather fuelwood. It is estimated that 40 percent of the land area of China is unsuitable for agriculture but suitable for forest crops. Much of this land is hills and mountain

slopes near densely populated areas. Much of it is unproductive now, except for poor-quality shrubs and grasses cut by fuel gatherers, and for poor-quality fodder grazed by livestock. No hardship would be involved in reforesting most of this area if an agreement could be made with the fuel gatherers for controlled cutting.

Not only is organic matter removed from the soil and none returned, but the bare soil is exposed to erosion by wind and water, and soils that were fertile are rapidly being rendered incapable of supporting plant growth. Good farm and forest lands, which once extended far to the northwest, are now a desert as a consequence of the removal of trees and vegetation that had previously acted as natural windbreaks and as soil-holding agencies. Annually, the northwest wind brings the desert farther down into China proper. In co-operation with the provincial governments, the Ministry of Agriculture and Forestry recently initiated a program of growing a sand-arresting forest zone along the border of the desert area. This shelterbelt, as planned, is to be more than 3,200 kilometers long and about 3.2 kilometers wide, using grass and shrubs to hold the sand and trees to break the force of the wind. More than 80 hectares of nurseries have been established.

The heavy silt content of almost all the rivers of China during the flood stage is sufficient indication of the tremendous soil erosion throughout China. During recent rains in Hunan, which caused heavy damage through flooding and silting, streams in the forested valleys were comparatively low and clear, giving visual evidence of the importance of forests in erosion and flood control. Last year the rains were heavy in Kwangtung, causing disastrous floods there. Soil erosion stations have been established in six provinces to study local soil-erosion conditions and to begin soil conservation work in co-operation with the bureaus concerned.

Wooden chutes are used for logging in Szechuan Province.

Forest Administration

In 1940, when Chungking had been definitely settled upon as the wartime capital and when it was decided that every effort should be made to intensify agricultural production, the new Ministry of Agriculture and Forestry was created. The Department of Forestry was made responsible for forest administration along the lines of a 5-point forest policy:

a. Development of forestry enterprises toward self-sufficiency in forest products.
b. Proper land utilization, including afforestation and reforestation of all land suitable only for the growing of trees.
c. All large-scale forestry enterprises to be undertaken by the Government.
d. Encourage, promote, and supervise the establishment and maintenance of private forests.
e. Intensified forestry research.

The Department was divided into three divisions to carry out these specific duties:

1. Administer forest laws. Make reconnaissance surveys of the national forest resources, classify and register forest and other lands, and maintain forestry statistics. Protect natural forests.

2. Select the best species for propagation and extension, and supervise reforestation, including public and private nurseries and forests.

3. Supervise forest management and forest conservation, including national forest resources, forest products utilization, and soil and water conservation.

The Ministry of Agriculture and Forestry and its Bureau of Forestry Research established forestry substations in the provinces. Each province had an Agricultural Improvement Bureau with several forestry substations scattered throughout the province. Many of the *hsien* (districts) within the provinces set up agricultural stations and forest nurseries. A number of universities have forestry departments and some have experiment stations and forest nurseries. There are also municipal forestry stations and private forestry stations.

The National Forestry Research Bureau, with 28 hectares of mountain land and 10 hectares for nursery practice, was established in Chungking to take charge of research work in China. At the beginning, with a very limited staff, the work was mainly concerned with reforestation of near-by mountain regions and demonstration work in water and soil conservation. Three divisions were set up, to cover work in silviculture, wood technology, and extension. After V-J Day the bureau was moved to Nanking, leaving the Southwestern Forestry Station in its original headquarters to continue the work in that region. At Nanking, the Sun Yat-sen Memorial Park Commission leased the Bureau 65 hectares of land on the Purple Mountain for its headquarters and nursery. Adjoining this land, a tract of about 320 hectares, partly covered with pine forest, was assigned for experimental work in co-operation with the horticultural department of the Memorial Commission. The work of the Bureau ex-

panded to include seven divisions, with substations in Peiping and Chungking, and seven forestry stations in the vicinity of Nanking. The total staff when this was written numbered 63 administrative officials, 117 technicians, and 86 regular laborers.

The seven forestry stations, having a total of 56 hectares in nursery land, raised 14 million seedlings and cuttings of 39 kinds of woody plants for reforestation purposes, and supervised their free distribution to farmers and their planting in special projects.

Soil conservation field work has been carried out in co-operation with other institutions for demonstration purposes. On the farmlands of the University of Nanking a soil erosion station was set up to study the correlation between rainfall and soil erosion under various cover crops. Much of the work has sought a means to prevent drifting sand from encroaching upon good farming soil: In the past year some 2,750 hectares of sandy land in Anhwei and 14,000 hectares in Honan were planted with willow cuttings.

The Division of Forestry Research has conducted forest surveys and tested various native woods for heat value, strength, and methods of preservation.

Reforestation

China is one of the timber-deficit areas of the world. Domestic production falls short of actual needs, especially since World War II. In order to meet the urgent demand, artificial planting on denuded areas for fuel and timber production has been carried out to some extent during the rehabilitation period after the war. Nursery land established has amounted to a total of 170 hectares with an annual output of tree seedlings up to nearly 27 millions. Seedlings used in plantations have numbered 230 million, corresponding to a planted area of 4,000 hectares.

In June 1947, 1,380 kilograms of American tree seeds, such as slash pine, *Pinus caribaea,* longleaf pine, *Pinus palustris,* white pine, *Pinus strobus,* bald cypress, *Taxodium distichum,* and American ash, *Fraxinus americana,* were received from UNRRA and distributed among 45 leading agriculture and forestry institutions in the war-devastated provinces for trial planting. The season was quite late for sowing and the results were not too encouraging, but in some parts of the country many species of foreign trees have done well.

With the help of FAO, the National Forestry Research Bureau, the Ministry of Agriculture and Forestry, the National Central University, and the University of Nanking drew up forestry projects to be financed from relief funds made available by the United States China Relief Mission (Post-UNRRA Aid to China). During March 1948 more than four million trees were planted on wastelands in the vicinity of Nanking. Most of these trees were grown in the nurseries of the National Forestry Research Bureau. A large number of trees have been planted each year by farmers who came to the nurseries and were given trees to plant on their own land. The China Relief Mission grant made it possible to plant large areas of publicly owned land. A further program was instituted for the adequate protection of these plantations and for greater understanding and co-operation in forestry among the various government bureaus and the local population. It was the hope to work out a system that could be applied in ther parts of China.

Floods in the fertile lowlands result from destroying the forests on the hill lands. Kwangtung Province.

During March 1948 more than two million cuttings of basket willow were planted, to help preserve dikes from erosion and to provide fuelwood and material for the basket-weaving industry. All over China budgets had been so reduced that the forestry stations were unable to hire labor to take up seedlings from the nurseries and plant them on near-by deforested hillsides. China Relief Mission funds were therefore made available for this purpose and the work was carried out.

Sand and Fire

Devastation by Yellow River floods, particularly during the war, have caused untold damage and destruction to many districts in Anhwei and Honan. Tracts of fertile farmland were covered with sand and strong winds picked up the sand and carried it onto other areas. To curb these shifting sands, the former CNRRA Anhwei Regional Office had made an effort to carry out reforestation in an area of 2,000 hectares in northern Anhwei. To continue the work of that office, the Anhwei Flood Area Sand Control and Reforestation Team of the Ministry of Agriculture and Forestry completed reforestation in another area of over 20,000 hectares. The same type of reforestation work done in Honan by the Honan Flood Area Sand Control and Reforestation Team covered an area of some 3,750 hectares.

The annual inward shift of desert sand in the Northwest, caused by the prevailing winds from that direction, is encroaching on more and more good farmland. To prevent and check this is the purpose of the Sand Control Forest Station established at Kingtai (Kansu) in 1947. Reforestation and grass plantation done by the station has covered an area of 270 hectares.

The prevention and control of forest fires is one of the most important aspects of forest protection in China. During the dry season, in the autumn in South China, almost every day some hillside is covered with flames. People set fire to the grasslands and forests, sometimes just to see the fire, sometimes so the rain can wash the ash down to the rice-paddies for added fertility, sometimes to destroy the forests, which may harbor bandits and wild animals. In some areas popu-

Later development of slope clearing for crops results in erosion of the topsoil, thus robbing the people of food supplies by ruining the land for future crops and adding to China's already tremendous forest problem. Shansi Province.

lation density forces families to a sub-subsistence level, and anything that grows is dug up by the roots for food and fuel.

Forest Utilization

Because of the inaccessibility of most of China's forests, no large-scale logging and milling has ever been attempted. Before World War II the total annual production of lumber was only about 16 million m^3 (excluding Taiwan). Production during the war was much lower. Annual production since the war has been estimated at 9 million m^3, including some 600,000 m^3 produced in Taiwan.

According to registrations with the Ministry of Industry and Commerce, the forest products industry comprises 24 sawmills, 8 rosin plants, 9 paint and lacquer plants, 1 papier-maché mill, 1 plywood mill, 1 camphor plant, and a number of charcoal kilns and miscellaneous plants.

Forest Education and Personnel

Modern forest education has gained increasing impetus during the last twenty years. China has 25 universities or colleges that give regular or elective forestry courses. Vocational agriculture and forestry schools number 40, with a total of 940 forestry graduates. The graduates of both the universities and the vocational schools are working with the various organizations concerned with forestry, with educational institutions, and with local governments.

According to the postwar reconstruction program as projected, China would require about 1,850 professionally trained foresters and about 4,720 vocational school forestry graduates by 1950. As compared with the above figures, this means that if the program is to be carried out China will have to educate 730 more forestry students in colleges and about 3,500 more in vocational schools within the next two years.

Rehabilitation and Development

For the rehabilitation and development of forestry in China, the Department of Forestry, Ministry of Agriculture and Forestry, has established these work projects:

1. Long-range Reforestation. This 30-year project deals with the establishment and exploitation of economic forests, fuel-production forests, protection forests, and national-defense forests.
2. Reforestation by Garrison Troops. This project call for the reforestation of 550,000 hectares of wasteland by garrison troops in various parts of the country in ten years.
3. Demonstration Reforestation. This ten-year project to reforest for demonstration purposes has been planned for Chingliangshan (Nanking), Sungshan (Honan), and Sishan (Peiping).
4. Sand-Control Reforestation in the Northwest. To prevent shifting sands from encroaching upon good farmland, this 30-year project aims to build up a forest belt in the Northwest provinces.

During the Japanese invasion and many other periods of political disorder, the spirit of long-range planning was replaced by momentary expediency, and plantations and forests were destroyed that had taken years to develop. Internal disorder still hinders the execution of a nation-wide program. Through experience the people are reluctant to give full support to a long-time program until they can feel confident of the future. The government seems to have realized this, for an exceedingly small percentage of the total national budget has been allocated to agriculture and forestry work. However, in spite of insufficient personnel and equipment, there are many forest stations and forest nurseries throughout China doing excellent work in reforesting, experimenting, and educating for the future.

Photos accompanying this article furnished by the Department of Forestry, Ministry of Agriculture and Forestry, China.

Pulp and Paper from Australian Eucalypts

BY W. E. COHEN

MOST of the forest areas of Australia occupy a narrow coastal belt extending from the southwest of western Australia to northern Queensland, as shown in Figure 1.

The outstanding feature of these areas is the overwoods, of which the dominating species are of the genus *Eucalyptus*. A typical example of one of its many species is shown in Figure 2.

Softwoods, or non-pored woods, indigenous to the country occur in very small quantities. Even with the recent development of plantation-grown exotic pines, covering approximately 61,000 hectares (150,000 acres), the quantities of softwoods are quite inadequate to meet the demand for such timbers for purposes not including pulpwood. Consequently, it was realized long ago that if a pulp and paper industry was to be established in Australia, it would have to be based on the utilization of hardwoods and especially of eucalypts.

These circumstances have tested the resourcefulness of the Australian research worker.

Twenty Years of Research

Investigations in Australia, where until recent years there was no wood-pulp industry, have done much to destroy the old fallacy in papermaking—that good quality paper could be made only from

Fig. 1. Distribution of main forest areas in Australia.

Fig. 2. A typical stand of Eucalyptus regnans *in Southern Tasmania.*

long-fibered pulps derived from coniferous woods. Until a decade or so ago hardwood pulps, manufactured by the soda process, were used as "fillers" in book and magazine papers because their bulky nature lent softness and opacity to the sheet. Attempts to convert hardwoods to pulps for other purposes resulted in low yields of hard-to-bleach pulps which, because of the shortness of their fibers, were believed incapable of producing anything but a weak sheet.

The very name "hardwood," which is so misleading because some hardwoods are softer than some softwoods, probably played some part in creating this fallacy. In general terms, the pulping of wood involves the treatment of wood chips with certain chemical solutions at elevated temperatures and pressures so as to dissolve the fiber-encrusting materials, lignin and associated polyuronides, and to leave as a residue the isolated cellulose fibers and the associated hemicelluloses which are so essential to good-quality pulp. It was easy for the idea to grow that hardwoods require more drastic treatment than softwoods. Generally speaking, the reverse is the case. Hardwoods contain less lignin and require proportionately less chemical in pulping; hardwood lignin and other fiber-encrusting materials are more vulnerable to chemical agents than their softwood counterparts. The length of the hardwood fiber is approximately 1 mm.; that of softwood tracheids 2.5 to 3.5 mm. Their diameters, however, are in the same proportion and consequently the ratio of length to diameter is the same for both fibers. The ratio rather than the fiber length is all-important in determining many of a pulp's papermaking qualities.

Recognition of these points was the fundamental factor in the successful establishment of the Australian pulp and paper industry. Conversely, the failure to recognize them did much to hinder an earlier development of the hardwood pulp industry overseas. It has now been convincingly demonstrated that, by suitable treatment, hardwoods can be made to give high yields of easily bleachable pulp which, by appropriate conditions of beating, can produce high-class papers of almost any quality, except perhaps high tearing resistance.

Attention was first directed seriously to the subject in Australia as a result of the shortage of papermaking materials during World War I. By 1918 sufficiently promising results had been obtained to justify a grant from the Western Australian Forestry Department to carry out a more systematic investigation.

In 1920, the investigations were taken over by the Commonwealth Advisory Council for Science and Industry and were extended to cover timbers, principally eucalypts, from states other than Western Australia. A special laboratory was set up with equipment, largely improvised, but including a model Fourdrinier paper machine making a sheet 10 cm (4 in.) wide at the rate of about 1.2 m. per minute (4 f.p.m.). This machine was purchased with a grant made by four newspaper companies in Western Australia. Small though it was, it was used to prove that pulp could be felted satisfactorily on a moving wire. Previously all sheets had been handmade and this introduced a personal factor which, in those days, was difficult to overcome. With the later development of standardized equipment and techniques for making laboratory handsheets, this machine has become more or less a museum exhibit although it has, on occasion, been used for publicity and educational purposes. It is shown in Figure 3.

In 1922 the first semicommercial tests were made at Geelong, Victoria. Here printings and writings were successfully made from 75 percent bleached soda eucalypt pulp and 25 percent imported long-fibered pulp on a 213-cm. (84-inch) machine at 46 m.p.m. (150 f.p.m.). By 1923 industrialists were taking an active interest. In 1924 and 1925, under the auspices of the Commonwealth Institute of Science and Industry, investigations began into the application of the sulphite process to eucalypts. In addition, an interested industrial group sent 200 tons of Tasmanian logs to Holland for mill-scale tests to determine the suitability of eucalypts for newsprint production. These investigations gave satisfactory results, but they disclosed the need for further investigations to overcome certain difficulties.

In 1928 a complete pilot plant was erected at Kermandie, Tasmania. It included a digester for sulphite cooking, with a capacity of one cord of wood, a three-pocket grinder, an 86-cm (34-inch) fourdrinier machine, and all the required accessories. The experiments at Kermandie, which lasted about 2½ years, covered sulphite pulping, grinding, bleaching

and decolorizing, and the conversion of pulps to several grades of paper. They were followed by large-scale runs on a 305-cm (120-in.) machine at Fairfield, Victoria. These demonstrated that eucalypt woods, subject to certain modifications of oversea practice, were amenable to grinding and that *Eucalyptus regnans* was superior to other eucalypts for this purpose. They demonstrated that standard equipment contained too much iron, which reacted with tannin to produce an off-white or greyish pulp and that it would be necessary to construct groundwood preparation equipment from materials that do not react with tannin.

Although these results were convincing enough, no immediate move was made to set up a full-sized plant. By 1934 some of the leading Australian newspaper groups became interested and formed the Derwent Valley Paper Co., under the auspices of which 100 tons of good quality *E. regnans* groundwood was prepared at the Kermandie pilot plant and shipped, along with a considerable greater tonnage of eucalypt woods to the Pacific Mills Co. at Ocean Falls, British Columbia, Canada. The groundwood was blended with a proportion of Ocean Falls long-fibered sulphite to yield a high-grade newsprint on a high-speed machine. Additional grinder runs on the eucalypt wood, together with the paper-making test, confirmed earlier experimental data obtained at the Kermandie plant.

Application of the kraft process in Australia began with some experiments on an exotic wood—plantation-grown *Pinus radiata.* These experiments, which were carried out by the Council for Scientific and Industrial Research, reached the pilot-plant stage in 1927. Previously, research at Canton, North Carolina, U.S.A., obtained good results by blending eucalypt pulp, prepared by the sulphate process, with a proportion of longer fiber in the manufacture of book and high-grade papers, and they recommended this process. In 1932, the Australian Paper Manufacturers Ltd. turned its attention to the kraft process; preliminary laboratory tests on *E. sieberiana* gave highly promising results. Two years later, a small semicommercial plant was operated at Botany, New South Wales. In addition to confirming the earlier laboratory results, it proved that satisfactory runs could be obtained on the paper machine. The matter was then taken up in earnest by that company and by the end of 1937 a pilot mill, producing 10 tons of pulp a day, was in operation at Maryvale, Victoria. During the erection of this plant further laboratory studies were carried out, involving the variation within and between trees of *E. sieberiana* and the correlation of chemical and physical properties of the wood with its pulping properties. These tests were made by the paper company in cooperation with the Division of Forest Products, Council for Scientific and Industrial Research. Bleached and unbleached krafts were produced at the Maryvale pilot mill, and were used in the various paper and board mills of the company in order to gain further experience in processing and utilization. The results, together with some apprehension about the imported raw-material situation, upon which the company's various mills were almost solely dependent, led them to embark without delay on the erection of a full-scale pulp mill, originally designed to produce 90 tons a day but subsequently increased to about 140 tons a day.

Research on the utilization of eucalypts for the production of industrial cellulose was really a product of World War II. Some attention was, however, given to this matter during the period already discussed. Now, twenty years later, considerable interest is being shown in the possibilities of eucalypts woods for this purpose. This matter is mentioned here because it harmonizes with the moral of the story just told, that it takes the greater part of a quarter of a century to overcome prejudice and conservatism in an old-established industry and that only under circumstances of emergency, such as a shortage of raw materials, can a new idea take root.

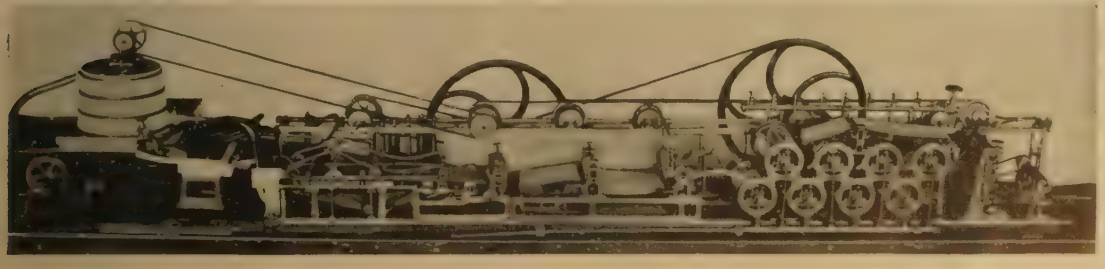
The Fruits of Endeavor

Allowing for recent expansion, the Australian pulp and paper industry represents a paid-up capital investment of more than £10,000,000. More than half of this industry has resulted directly or indirectly from research carried out in Australia.

There are three main pulp mills, each using a different process—soda, groundwood, and kraft. These are discussed briefly below.

Associated Pulp and Paper Mills Ltd. operates a soda-pulp mill at Burnie, on the northwest coast of Tasmania. The Company was inaugurated in 1936 with a paid-up capital of £1,500,000, which was doubled for the company's postwar expansion program. Production started in 1938 and operations were based initially on the original investigations using the soda process on eucalypt pulps. By means of research concurrent with its operations, this company has improved the quality of its products, the yield and cost per ton, and the overall output of its

Fig. 3. Model 4-inch Fourdrinier machine which was used in early experiments on the pulping of eucalypt hardwoods.



pulp mill. Pulpwood is drawn from eucalypt forests of northwestern Tasmania, the chief species being *E. obliqua, E. gigantea, E. amygdalina,* and *E. viminalis.* The mill produces a wide range of fine writing and printing papers, hard and soft-sized duplicating paper, blotting and cartridge paper. Some grades are furnished with 100 percent eucalypt stock and the over-all furnish averages 90 percent of bleached soda eucalypt pulp, the balance being imported long-fiber and non-fibrous materials. The mill produces its own caustic soda and chlorine in an adjacent electrolytic plant. Two paper machines are operated; a 457-cm (180-in.) machine with a maximum speed of 240 m.p.m. (800 f.p.m.) and a 229-cm (90-in.) machine with a speed of 120 m.p.m. (400 f.p.m.). Machine speeds of at least 190 m.p.m. (620 f.p.m.) are common with high-percentage eucalypt furnishes. A third machine is almost ready to go into production. The present rated output is 20,000 tons of paper per year and 18,000 tons of pulp per year. Because of shortages of labor and materials, the actual output is lower; 17,500 tons of paper were produced in 1946-47. During World War II this mill was the sole source of fine writing and printing papers for the whole of Australia.

Australian Newsprint Mills Ltd. operates a newsprint mill at Boyer, a small settlement 35 km (22 miles), from Hobart, Tasmania. The company was registered in March 1938 with a nominal capital of £4,000,000 of which £1,500,000 was paid up. Towards this amount, the Tasmanian Government loaned £250,000, which has since been repaid. Substantial amounts were invested by the proprietors of several leading Australian newspapers. Construction of the mill began early in 1939 and production started early in 1941. The mill (Figure 4), consisting of buildings costing £250,000 and equipment worth £650,000, is situated on the banks of the Derwent River. Much of the equipment was manufactured in Australia using, where necessary, materials that would not stain the groundwood by reaction with wood tannins.

The mill draws its pulpwood supplies from 1,000 km^2 (400 square miles) of concession territory within 100 km (60 miles) of Hobart on the Derwent River and its tributaries. The wood is handled by the largest logging plant in Australia at the rate of 250 tons per day. Groundwood is prepared chiefly from old trees of *E. regnans,* but the woods of young trees of this species and of *E. obliqua* and *E. gigantea* are also used in smaller quantities. Wood unsuitable for grinding is used as fuel.

The groundwood plant is equipped with Australian-made grinders, using both natural and artificial stones. Groundwood, proportioned with approximately 17 percent of Canadian news sulphite, is made into newsprint on a 411-cm (162-in.) machine at speeds exceeding 300 m.p.m. (1,000 f.p.m.). Although the rated capacity of the mill is 30,000 tons per year, the output was actually 32,000 tons in 1946-47. During World War II, the mill's output was used in a pool which kept the Australian newspapers in circulation although they were of course drastically reduced in size. The printing qualities of newsprint depend mainly on the properties of the groundwood. The successful production of newsprint from *E. regnans* and, to a lesser extent, from other eucalypts, proves that their groundwoods have the necessary properties.

The Australian Paper Manufacturers Ltd. operates a kraft pulp mill at Maryvale, Gippsland, Victoria. This mill, which started production in 1939, has a capacity of 40,000 tons per year, of which 20,000 tons is bleached. Nine species of eucalypts are used: *E. regnans, E. sieberiana, E. gigantea, E. eugenioides, E. obliqua, E. goniocolyx, E. capitellata, E. consideniana,* and *E. muelleriana.* During the years following the disastrous forest fires of 1939, fire-killed timber was used in large quantities. Much of the eucalypt kraft is blended with imported long-fiber kraft and converted to paper on a 457-cm (180-in.) machine at Maryvale. The remainder of the mill's output is lapped and transported to other company-owned paper mills at Melbourne and Sydney. The company's total annual output of paper and board is 125,000 tons. It manufactures a variety of paper products in the furnish of which the eucalypt component varies from 35 to 90 percent.

Research Continues

Reference has been made to the co-operation between the Australian Paper Manufacturers Ltd. and the Division of Forest Products, C.S.I.R., in the application of the kraft process to *E. sieberiana.* In 1937, with the establishment of the two other companies and with production in sight, attention was turned to the future research needs of the Australian pulp and paper industry. Each company had set up its own research groups to handle problems specific to its own process and raw materials. But there was still a need for an organization to study fundamental problems of the industry as a whole. The industry looked to the Division of Forest Products to undertake this work. Since 1937, the work of the Wood Chemistry and Wood Structure sections of the Division of Forest Products, C.S.I.R., has been partly subsidized by grants from the Australian industry and, more recently, by Forest Products Ltd. of New Zealand.

The main object of this co-operative research work is to seek and disseminate fundamental information on the chemistry, physics, and structure of the hardwoods which serve as raw materials to the industry. Consideration is also given to the standardization of pulp evaluation methods and equipment, to the numerous fundamental factors which influence the processing of pulp, and the strength of a sheet of paper.

The Division of Forest Products has trained personnel and specialized equipment necessary for work of this caliber. One of the several laboratories devoted to this work, the pulp-evaluation laboratory, is shown in Figure 5. It has British standard sheet-making equipment, various types of laboratory beaters, stock dividers, which are used to sample pulp suspensions accurately, and accessory equipment.

Broadly speaking, the work is carried on under the following headings:

1. Structure of woods and of their tracheids and fibers.
2. Chemistry of wood polysaccharides.
3. Chemistry of lignin.
4. Methods of wood and pulp analysis.
5. Methods of pulp evaluation and paper testing.

Information on the structure of wood is fundamentally important to the wood-pulp manufacturer. Structure plays an important role in the penetration

of pulping chemicals and determines the conditions that must be employed to secure a satisfactory cook. Structure also influences the amenability of woods to grinding.

Fiber structure is even more important. In order to be able to develop strength in a sheet of paper, pulp must be subjected to mechanical treatment to induce in the fiber structure certain modifications, such as fibrilation, the nature and extent of which are related both to the fiber structure and to the equipment required. Elucidation of the structure of the wood-pulp fiber and of the physical changes it undergoes in processing is being undertaken in order that the Australian pulp and paper industry may understand more clearly what it is doing or has to do to its fibrous raw materials.

Abnormalities in wood structure such as reaction wood, brittle heart, slip planes, and minute compression failures give rise to abnormal wood-pulp fibers. Information on causes and effects is invaluable in the selection of pulpwood, especially that intended for the manufacture of groundwood.

Chemical pulping of wood involves the recovery of cellulose and some associated polysaccharides with the simultaneous removal of some or all of the lignin and some polysaccharides. The chemical makeup of wood substance is far from clear. It has not been proved, for instance, that chemical bonds exist between lignin and cellulose, between cellulose and its associated hemicelluloses, or between lignin and hemicelluloses. Proof or otherwise of the existence of such bonds and information on their susceptibility to chemical reagents would lead to a clearer understanding of pulping processes. Likewise a more intimate knowledge of lignin and its reactions would not only facilitate the development of more rational pulping processes but could lead to the exploitation of lignin as a natural raw material. At present it is largely a waste product of pulp mills. The recovery of [illegible] trial cellulose from wood involves not only [illegible] and bleaching but also chemical methods of refining to rid the cellulose of associated polysaccharides. It is not known with certainty whether these polysaccharides coexist with cellulose in the form of mixed crystals, or as mixed chains, or whether their relationship is chemical or physical in nature.

Research on eucalypt wood lignin is being actively carried on by the Division of Forest Products to provide the pulp and paper industry a clearer concept of the chemical composition and reactions of this material. For this purpose, methanol lignin, prepared by extracting wood meal with methanol at 150°C., is used because it is considered to resemble more closely the natural lignin than lignin products isolated by other methods.

The association of cellulose and other polysaccharides in wood is being studied by fractionating holocellulose (i.e., wood tissue from which only lignin has been removed) and by studying the molecular weight frequencies of the various fractionation residues. It has been shown that removal of pentosans results in a decrease of the average molecular weight with the polymerization degree frequency shifting to a zone of lower polymerization. This could be taken as proof of the existence of mixed chains, the removal of pentosans resulting in a shortening of chain length. However, there is still the possibility of degradation of pure cellulose chains by the reagent employed for the removal of adjacent pentosan chains. Hence the picture of the cellulose-hemicellulose relationship is far from clear and is still being actively studied.

Methods of wood and pulp analysis are essential to the assessment of woods and pulps in the control and development of pulping processes. For the profitable use of information exchanged on such matters it

Fig. 4. Modern newsprint mill which uses 83 percent of eucalypt groundwood in its newsprint furnish. Boyer, Tasmania.

Fig. 5. Pulp evaluation laboratory of the Wood Chemistry Section, Division of Forest Products, C.S.I.R., Australia.

is essential that methods be standardized. In collaboration with the industry, the Division of Forest Products has investigated, improved, and finally adopted standard methods. Some of these differ from those employed elsewhere, in particular the methods of sample preparation, the holocellulose determination, the pentosan determination, and improvements in the methods for determining Cross and Bevan cellulose, lignin, and various extractives.

The buying and selling of pulp and paper, the development or improvement of pulping processes, and the control of pulp and paper manufacture depend on methods for evaluating pulp and testing paper. A thorough study has been made of the variables of laboratory beating equipment and methods, of handsheet making, and of paper-testing instruments and methods. Laboratory pulp testing is facilitated by accurate sampling of pulp stock; for this purpose special equipment known as stock dividers has been designed and developed. These are now in use throughout the Australian industry and other countries are showing an interest in them. In collaboration with the industry and with a Melbourne instrument technologist, the division has developed an accurate instrument for measuring the internal tearing resistance of paper. This instrument is now standard throughout the industry and models are soon to be exported, and it is expected that the instrument will find more general application.

Technical Co-operation

The results of all investigations related to the pulp and paper industry and carried on by the Division of Forest Products are discussed annually at Pulp and Paper Co-operative Research Conferences. These are held in rotation in Burnie, Hobart, and Melbourne, and are attended by research personnel from industry and from the division. In recent years, papers on the results of investigations carried out in the industry itself have been contributed and discussed. The reports given at these conferences, together with the informal discussions which follow, are reproduced and distributed throughout the world on a restricted scale.

Arising from these conferences is the co-operative purchasing scheme. This not only concerns the regular purchase of laboratory stores to ensure that each party uses materials of identical grade and quality, but also the design, purchase, testing, and correlation of new equipment.

These conferences, continued since 1939, have brought together a limited group of the technical personnel of the pulp and paper industry. By 1945 it was felt that the conferences had been so successful that a similar opportunity for exchange of ideas should be extended to all technical personnel. A provisional committee was formed in 1946, and early in 1947 the Australian Pulp and Paper Industry Technical Association held its First Annual Meeting and First General Conference in Melbourne. The Second Conference was held this year in Hobart, and plans are maturing for the Third Conference in Sydney, New South Wales, in February 1949. The association publishes its proceedings, the second volume of which is now in the press.

The Industry Expands

World War II gave the Australian pulp and paper industry an opportunity to mature rapidly. The country's sole dependence on the industry's products did much to overcome the prejudice usually shown toward new products. Both the trade and the consumer soon became accustomed to papers made from eucalypts. Initial success has stimulated the industry to expand. The caliber of eucalypt pulps has become well known abroad, and oversea capital is being attracted to the industry.

The Associated Pulp and Paper Mills Ltd. is installing two new paper machines with accessory equipment and is enlarging its soda pulp mill. By 1951, the output of fine printing and writing papers is expected to exceed 39,000 tons a year. The company, in association with Thomas Owen & Co. Ltd. of England, recently registered Thomas Owen & Company (Aust.) Ltd. with a nominal capital of £3,000,000. This new company will establish a second paper mill at Burnie, Tasmania, for the manufacture of vegetable parchment, greaseproof, glassines, and other specialty papers. Eucalypt pulp and utility services will be supplied by the Associated Pulp and Paper Mills Ltd., and a large proportion of the equipment and technical assistance will be provided by Thomas Owen & Co. Ltd.

A further development is the subject of negotiation between this new company and the British Coated Board and Paper Mills Ltd. It is proposed to establish at Ballarat, Victoria, a mill for the production of coated papers based on eucalypt pulps. The operating company will be Ballarat Paper Mills Pty. Ltd. with a nominal capital of £1,000,000. Special equipment will be imported.

The Australian Newsprint Mills Ltd. is enlarging its groundwood plant by installing ring grinders. A 625-cm (246-in.) paper machine is shortly to be assembled. The company expects to produce 80,000 tons of newsprint a year by the end of 1950.

Reference has already been made to Australia's lack of long-fibered softwoods. It has been necessary to import long-fibered pulps, mainly from hard-currency countries. Prices went up 70 percent over a recent period of 12 months. Attention has therefore been turned to the softwood resources of New Zealand. In the government and private forests of that country, plantation-grown *Pinus radiata* occupies an area of nearly 200,000 hectares (500,000 acres) and it is estimated that these forests are capable of yielding 2,600,000 m^3 (1,000,000 cords) a year. New Zealand Forest Products Ltd., whose *P. radiata* resources occupy 61,000 hectares (150,000 acres), operate four sawmills. The slabs from some of these mills are converted to insulating and double-faced hardboards for building purposes.

This company has established a research laboratory, which investigates the suitability of its raw material for various grades of pulp. Pilot-plant experiments have been carried out in the United States and have demonstrated that New Zealand-grown *P. radiata* yields kraft pulp that can meet the rigid specifications for multi-wall bag paper. A multi-wall bag plant has been established, but it is now using imported paper. When the pulp and paper program of the company is further developed, raw material for this plant will be made from *P. radiata*.

The company is establishing a kraft pulp mill after the designs of K.M.W. of Karlstad, Sweden. Originally, the capacity of this plant was to have been 10,000 tons per year but it was recently announced that a further £800,000 is to be used to increase its capacity to 25,000 tons. Half of the output will be shipped to Australian Newsprint Mills Ltd., for proportioning with eucalypt groundwood in the manufacture of newsprint.

The New Zealand State Forest Service has arranged trials of *P. radiata* in co-operation with the three main Australian pulp and paper companies to investigate the manufacture of kraft pulp and its proportioning with eucalypt kraft, soda, and groundwood pulps. The Forest Service has under consideration the erection of a large integrated plant consisting of sawmills, groundwood mill, kraft pulp mill, and newsprint mill. If the grinding is confined to sapwood and the resinous heartwood is not used, it has been demonstrated that a good grade of newsprint can be made. *P. radiata* has been ground for some years for cardboard manufacture by another New Zealand Company Whakatane Paper Mills Ltd., which produces 12,000 to 15,000 tons of board per year.

Expansion plans of the Australian Paper Manufacturers Ltd. encompass the improvement of existing plant and the installation of new units to meet the increasing demand for board and paper products. Expansion plans for the industry as a whole also envisage better and more efficient utilization of its wood resources by means of the integration of pulping with sawmilling, peeling, and the manufacture of building boards. Reduction of waste by means of efficient barking methods is also contemplated; hydraulic barking equipment will shortly be installed by Associated Pulp and Paper.

Conclusions

A large and thriving industry, based on the utilization of eucalypt hardwoods for the manufacture of high-quality papers of all grades, has been established in Australia as the result of research which extended over a quarter of a century.

Although eucalypt fibers are short, they are proportionally thin and consequently their felting properties are not impaired. They have a far more important use in papermaking than that of the usual run of oversea hardwood pulps, which are used largely as "fillers." Newsprint furnished with eucalypt groundwood possesses excellent printing properties which, rather than strength, are the most important criteria. Mild cooking methods preserve the high pentosan content of chemical eucalypt pulps, which is responsible for the ease with which they are processed and for improvement to the formation and finish of the eucalypt-furnished sheet.

Eucalypt pulps make their full contribution to the bursting and tensile strengths of a paper. Their contribution to tearing strength is not inconsiderable but, in papers where a high resistance to tearing is desirable, it is usual to develop this property by proportioning eucalypt pulp with long-fiber. Australia lacks softwoods from which to derive long-fibered pulps and has had to import them from the Northern Hemisphere. New Zealand will soon supply Australia's long-fiber needs from plantation-grown *P. radiata*.

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Philippine Forests and Forestry

By FLORENCIO TAMESIS

THE forest is perhaps the most valuable replaceable natural resource of the Philippines. As a source of raw materials and revenue to the Government, it can be managed to yield for a long time more than it does at present. The latest estimate on the extent of the vegetative soil cover of the Philippines is as follows:

		Area in Hectares	*Percent*
Commercial forest		13,198,406	44.5
Noncommercial forest		4,296,786	14.4
Marsh:			
Fresh	168,657		
Salt	438,155		
		606,812	2.0
Open grassland		5,203,620	17.5
Cultivated		6,434,348	21.6
Total		29,740,972	100.0

Approximately 97.5 percent of the forest is owned by the Government and is administered by the Bureau of Forestry; 2.5 percent is privately owned.

The greater bulk of the forest is in large blocks on the principal islands such as Luzon, Mindanao, Samar, Negros, and Palawan. Most of the forest is of the tropical rain type, complex in its composition. More than 3,000 species of trees attain a diameter of 30 centimeters (one foot) or more; however, less than sixty of these are marketed. Seventy-five percent of the stand consists of dipterocarps, commonly called *lauan*, to which "Philippine mahogany" belongs.

It is conservatively estimated that the aggregate commercial standing timber is around 2,105,000,000 m^3 (r) (464,729,000,000 bd. ft.). Based on forest charges (government stumpage tax), this stand has a value of P2,341,550,000.[1] Its commercial value is placed at P58,092,434,000, based on a minimum price of about P26.5 per m^3 (r) (P120 per 1,000 bd. ft.).

[1]One peso is equivalent to $0.50 U. S

Smoking Mt. Mayon Volcano in Mt. Mayon National Park, one of the several scenic parks in the Philippines. The Bureau of Forestry administers national parks as well as national forests.

Under sustained-yield management, the forest could stand indefinitely a yearly cut of 32 million m^3 (r) (7,000 million bd. ft.).

Forest Types

Based on the composition of stands, Philippine forests may be classified into five broad types:

Dipterocarp Type. This is the forest type in which members of the Dipterocarp family form the predominating timber species, about 75 percent by volume. They thrive under a variety of conditions, from moist river bottoms to hilly and mountainous country, and make up the upper story in more or less pure stands. The lower stories consist largely of unmerchantable species, of shrubs and vines, including the rattans. From the lumberman's point of view, stands ranging from 100 to 200 m^3 per hectare are sufficiently heavy to warrant the use of mechanical means of extraction. This forest type is the main source of raw materials for the lumber industry. About 70 percent of the entire lumber output is represented by six species of the *lauan* family: White *lauan, Pentacme contorta;* red *lauan, Shorea negrosensis; tangile, S. polysperma; apitong, Dipterocarpus grandiflorus; yakal, Hopea* sp.; and *guijo, S. guiso.*

Molave Type. This type of forest is more open than the dipterocarp type and the volume of timber per unit is much less, averaging 30 m^3 per hectare. It occurs in regions where there are distinct wet and dry seasons, each of several months' duration. During the dry season, the vegetation is largely leafless, but in the wet season it grows luxuriantly. Under certain local soil conditions during the dry season, there are places approaching desert-like conditions. On dry limestone ridges *molave, Vitex parviflora,* predominates.

Most of the species found in this type of forest produce woods that are highly valued for their natural beauty and durability. Among the most important are *molave; narra, Pterocarpus* spp.; *tindalo, Pahudia rhomboidea; ipil, Intsia bijuga; akle, Albizzia acle;* and *banuyo, Wallaceodendron celebicum.*

Pine-type forests occur in the high mountainous regions of northern Luzon and Mindoro. The stand, as a rule, is open and scattered, averaging 45 m^3 per hectare. The principal species is the Benguet pine, *Pinus insularis,* while *tapulau, P. merkusii,* is found in the high mountains of Zambales and Mindoro. *Tapulau* is not as important commercially as Benguet pine. While the pines grow in practically pure stands, hardwoods are found in mixture with them in areas protected from fires, especially in draws at lower elevations. The timber of the Benguet pine is generally used for mining and general construction purposes in the Mountain Province. These two species of pine supply turpentine and rosin.

Mangrove type occurs on tidal flats at the mouths of streams and on the shores of protected bays. The species could be used for construction if they could be made more durable by treatment. The stand is composed mostly of about seven species of the Rhizophoraceae family. The mangroves are the principal sources of firewood, tanbark, cutch, dyewood, and charcoal.

Along streams in many parts of the tidal flats there grows the nipa palm, *Nipa fruticans.* Its leaves are used for thatch, its sap for the manufacture of vinegar, alcohol, wine, and sugar.

Beach type. Above high-tide limits are sandy beaches, where the original vegetation has been left undisturbed. The frontal zone usually consists of a tangle of vegetation, of which *pandan, Pandanus tectorius,* forms a conspicuous part. The principal trees are *talisai, Terminalia catappa; dapdap, Erythrina variegata* var. *orientalis; botong, Barringtonia asiatica; palomaria, Calophyllum inophyllum; agoho, Casuarina equisetifolia; bani, Xylocarpus moluccensis;* and *tawalis, Osbornia octodonta.*

Midmountain and Mossy Type. Forests of this type, found on high and very rough mountainous regions, are essentially protection forests. As a rule, rainfall and humidity are high. Exposed to strong winds, the trees are mostly dwarfed and usually covered with mosses, liverworts, filmy ferns, and epiphytic orchids. The principal species are *Dacrydium* spp., *Podocarpus* spp., *Eugenia* spp., *Decaspermum* spp., *Quercus* spp., *Myrica* spp., *Symplocos* spp., and *Tristania decorticata.*

Timber and Minor Forest Products

Philippine forest products are generally classified into two groups, namely (1) the timber, and (2) the so-called minor forest products, which include all products of the forest other than timber.

Principal Timber Species. From a commercial viewpoint the principal timbers may be grouped into six general classes: (1) the *lauans,* (2) the *apitongs,* (3) the *guijos,* (4) the *yokels,* (5) other dipterocarps, and (6) the legumes.

The *lauans,* or "Philippine mahogany," are the softer members of the dipterocarp family. The red *lauans* include *tangile, tiaong, Shorea teysmanniana,* and true red *lauan,* which constitute the dark-red Philippine mahogany. The white *lauans* include the real white *lauan; almon, S. eximia; bagtikan, Parashorea* spp.; *manggasinoro, Dacryodes incurvata; kalunti, S. kalunti;* and *mayapis, S. palosapis,* which constitute the light-red Philippine mahogany. The red and white *lauans* are moderately heavy and durable for interior work when used without sapwood. They are not suitable for heavy structure and exposure to the weather, except when the structure is so made that water sheds off, as in shiplap or in the so-called *rizal* or rustic siding. For house construction, the *lauans* can be used for siding, partitions, and ceiling and would give excellent results for light shipplanking.

Apitong is the most abundant of the heavier and stronger structural timbers of the dipterocarp family. It lasts for a long time when used without sapwood, not exposed to the weather or in contact with the ground. *Apitong* responds admirably to process treatment and is the most important framework wood used in wooden construction. Properly treated, *apitong* is the equal in durability of *molave, dungon, Tarrietia sylvatica, ipil,* and *yakal* for structures exposed to the weather and is superior to any of these for saltwater piling.

Guijo is similar to *apitong* in many respects, especially in color. *Apitong,* however, has larger pores and is inclined to be more resinous. The wood of *guijo* is strong, relatively easy to work and has good wearing qualities. It is best suited for beams and joists, for automobile and truck framing, and for other vehicles. For flooring it appeals to lovers of reddish-brown colors. Like *apitong,* the wood "moves"

Typical dipterocarp forest on Luzon Island. (1), Red lauan, Shorea negrosensis; *(2)* Tangile, Shorea polysperma; (*3*) Mayapie, Shorea kalunti; (*4*) *White* lauan, Pentacme contorta.

in process of seasoning and should be properly dried if the best service is to be expected. Once thoroughly dried, however, both woods "stay put."

The hardest and strongest member of the *lauan* family is *yakal.* This wood is resistant to decay, which makes it particularly suitable for structures exposed to the weather. It "moves" about as much as *guijo* and best results can only be obtained when it is well seasoned before using. It is an excellent substitute for *ipil* for house posts and bridge timbers, and is recommended wherever great strength and durability are required.

Some of the less abundant members of the *lauan* family are *palosapis, Anisoptera thurifera,* and *manggachapui, Hopea acuminata* (the latter is sometimes known as *dalindingan*). Real *manggachapui* is fine-textured, straight-grained, hard and heavy, white when fresh, but upon exposure to the sun it changes to a dark reddish-yellow. *Palosapis,* which is often substituted for *manggachapui* by unscrupulous dealers, is coarse-textured, moderately hard and moderately heavy, resembling in this respect the *lauans.* In color, it is yellowish, often with rose streaks. *Manggachapui* has most of the properties of *guijo* and can be used interchangeably with it, but *palosapis* has uses similar to the *lauans.*

Akle, narra, ipil, and *tindalo* all belong to the legume family, which furnishes most of the valuable cabinet timbers. *Akle* is brownish in color and is an excellent wood for cabinetmaking. It has many of the qualities of walnut and is more resistant to termites. *Narra* is reddish yellow to dark red. The yellow variety is more common and more readily obtainable than the red. For furniture and cabinetmaking and for door and window framing, *narra* is almost always the choice, although, for those who can afford the price, a still better wood is *tindalo,* a beautiful hard red wood that darkens with age. *Tindalo* keeps its shape remarkably well, and, like most members of the legume family, has a beautiful grain and is very durable. Another very popular wood is *ipil.* It is most commonly used for house posts on account of its great durability and strength. Before the practice became widespread of setting house posts on a concrete or stone foundation, *ipil* was one of the few woods that withstood the ravages of decay and ter-

mites. With the adoption of concrete foundations, even woods of moderate durability can be expected to last for many years.

Dao, Dracontomelum dao, of the Anacardiaceae family, is a beautiful wood now much in demand for cabinet and furniture work. It "moves" badly when fresh and should be well dried before using.

Minor Forest Products. All products of the forest other than timber constitute "minor forest products." Among the most important are firewood, charcoal, palm products, cutch and tanbarks, fibers, resins, gums, oils, rubber and gutta-percha, beeswax, and medicinal plants.

Licensing System. The principal governing administration of the forest is the protection of public interests—the utility and safety of the forest and its perpetuation in productive condition by wise use. The privilege of utilizing timber and other forest products for commercial purposes is granted by a system of licensing. There are long-term license agreements for timber or minor forest products covering a period of five to ten years, and "ordinary" or shorter-term timber and minor forest products licenses covering periods of one year only or two to four years.

The Director of Forestry must publicly announce through written notices posted at appropriate public places that certain forests are open for applications. Conditions for the cutting, collecting, and removing of forest products are specified and the public is invited to submit sealed bids. Applications can then be filed. Without such notices or advertisement, no application can be entertained.

Before a forest is declared open for application, the area is first inspected by a forest officer, who reports to the Director of Forestry on such points as the following: The extent of forest area; the existing quantity of particular forest products; the maximum allowable quantity to be cut every year; and the method of development or exploitation feasible. The objective is, insofar as permanent timberlands and established forest reserves are concerned, to develop the area under license on a sustained-yield basis. A license is nonnegotiable and nontransferable. If it is not used for a period of four months during its term of validity, that is sufficient cause for cancellation. One or more renewals of a license may be granted, provided the combined number of years covered by the original license and its subsequent renewals shall not exceed 50 years.

Studies of the growth of Philippine forests show that the annual volume growth averages about 1.5 percent. The annual allowable cut therefore is 1.5 percent of the total volume of available or merchantable timber. However, clear cutting is usually allowed on agricultural land and in potential agricultural areas.

To ensure natural reproduction and as a means of regulating the cut on permanent timberlands, diameter limits have been adopted, below which no cut is allowed. The remaining forest growth is expected to take care of the natural regeneration of the logged-over areas. As provided in the license, the diameter limit for cutting is, according to species groups, as follows: Species of the first group, 60 centimeters; those of a second group, 40 centimeters; and all dipterocarp species like *apitong, lauan, tangile*, etc., 50 centimeters, except *yakal* and *guijo*, which belong to the first group.

The new Philippine reforestation tax is used to establish pine plantations after logging, such as this one on a Cebu Reforestation Project.

Forest taxes. A forest charge (stumpage tax or government royalty) is collected for the timber cut. For this purpose, all timber species in the Philippines have been classified into four groups. For timber in the first group, a charge of P3.50 for every cubic meter is collected by the Government, P2.00 for the second group, P1.25 for the third group, and P0.60 for the fourth group. In addition, a reforestation tax on all timber cut in public forests for commercial purposes is collected at the rate of P0.50 for every cubic meter of the first and second groups, and P0.40 for the third and fourth groups. A special assessment is provided on *molave, camagon, Diospyros discolor*, and ebony, *D. ferrea*, depending upon whether the log has sapwood or is purely heartwood.

Free use. Under present laws and regulations, a reasonable quantity of timber is granted free for public works and to religious institutions. Individuals may also be granted timber for their personal use. If an individual is a resident of a city or municipality owning a communal forest, the timber must be obtained from it. In the absence of a communal forest, a free license may be granted to cut in the public forests.

From the organization of the Bureau of Forestry under the American regime in 1900 until 1941, the Philippine lumber and timber industry had a remarkable growth and development. During the Spanish administration of the Islands, logging had been done by slow and wasteful hand or animal power. There were a very few small sawmills of the gang type, run by steam or water power, and these were mostly in the city of Manila. Very limited information was available on the Philippine forests—their extent or logging possibilities; the timber species of potential commercial value were unknown. Among the first problems that the Bureau of Forestry had to undertake were the reconnaissance of forest areas, the classification of timber species, the determination of their strength, durability, and other qualities. As a result of the basic information gathered, operators with more capital were attracted to the industry. Power logging was introduced and modern bandsaw mills were installed.

Up to 1906, the Philippines had practically no export trade in lumber and timber. In 1907 there was exported 595 m^3 (s) (252,000 bd. ft.) of lumber, mostly to the United States. On the other hand, 38,500 m^3 (s) (16,316,000 bd. ft.) of lumber, principally from

Tractor yarding and logging of red lauan *using D-7 and D-8 caterpillar tractors and arches.*

the United States, was imported during that year. Since then, up to the outbreak of World War II, lumber and timber exports increased considerably and lumber imports correspondingly decreased. In 1941, 520,000 m^3 (r) (114,900,000 bd. ft.) of logs and 175,000 m^3 (s) (74,100,000 bd. ft.) of lumber, or a total of 446,000 m^3 (s) (189,000,000 bd. ft.) of lumber valued at P8,041,389 were exported from the Philippines. In that same year 4,935 m^3 (s), the equivalent of 2,091,000 board feet of lumber, valued at P256,936, was imported. The imports consisted mainly of lumber and timber for special purposes.

Total annual timber products snowballed from 94,000 m^3 (s) (40 million bd. ft.) of lumber in 1901 to over 2¼ million m^3 (s) (1,000 million bd. ft.) in 1940. The steady increase in production was, however, interrupted by World War II, during which most big sawmills were destroyed. At the outbreak of hostilities in the Pacific in December 1941, there were 163 sawmills with a combined daily capacity of 3,996 m^3 (s) (1,693,000 bd. ft.), representing an estimated investment of P46,000,000 and employing some 70,000 persons.

Postwar status of the industry. After the liberation in 1945, only 38 of these sawmills were left, with a total daily capacity of 687 m^3 (s) (291,000 bd. ft.). Rehabilitation of the Philippine lumber and timber industry, however, has shown rapid progress since the end of the war.

Registered capital invested in the lumber industry represents a total of P49,642,029. Investment in sawmills and logging equipment is P38,094,705. The difference of P11,547,324 represents the capital invested by small licensees.

During the fiscal year 1940-1941, just before World War II, there were in force 19 long-term timber licenses and 1,189 ordinary timber licenses, or a total of 1,208 licenses, with a total production of 2,221,000 m^3 (s) (941,600,000 bd. ft.) in logs or lumber. Of this amount, 348,800,000 board feet were of sawn lumber, the balance of 592,800,000 board feet in logs.

During the fiscal year 1947-1948, there were in force 22 long-term timber licenses and 1,697 ordinary timber licenses, or a total of 1,719 licenses, covering forest areas of 2,655,208 hectares with a total annual allowable cut of 7,500,000, m^3 (r) (1,650 million bd. ft.). There were also in force 1,602 licenses for ordinary minor forest products. Of these, 568 licenses were for rattan and 471 licenses for firewood, and the remainder for resins, nipa, vines, etc.

Number of sawmills. As of 30 June 1948 there were 207 sawmills with complementary power logging equipment and 135 sawmills without logging operations, or a total of 342 sawmills. These sawmills have an aggregate daily capacity of 5,220 m^3 (s) (2.212,-000 bd. ft.). While the number of these sawmills exceeds that existing before the war, they are smaller mills.

Volume of production. Timber production is already approaching prewar size, that during the fiscal year ending 30 June 1948 being 3,610,000 m^3 (r) (797,100,000 bd. ft.) as compared with the prewar figure (1940) of 4¼ million m^3 (r) (942 million bd. ft.) (log scale). For the fiscal year 1947-1948, the total lumber output was 788,000 m^3 (s) (334 million bd. ft.). With additional mills under construction and the improvement in logging and sawmilling operations now in progress, output is expected to exceed a thousand million board feet next year.

Labor. The supply of labor in the lumber industry is not a problem. Labor to handle sawmilling and logging equipment is also readily available, thanks to a natural Filipino aptitude for handling machinery. About 50,000 persons are employed in the lumber industry.

Domestic market. Manila is the principal lumber and timber market for domestic consumption. In 1947-1948, there were 454,000 m^3 (s) (192,500,000 bd. ft.) of sawn lumber, 11,800 m^3 (s) (5 million bd. ft.) of squared timber and 36,500 m^3 (r) (8,050,000 bd. ft.) of logs shipped to Manila, representing a value of P44,804,383 in trade.

Exports. Export trade is generally direct from mills in the outports. In view of the magnitude of destruction suffered by the Philippines and the large quantities of lumber needed for reconstruction, there are temporary restrictions on exports. This ban, imposed after the establishment of the republic, was lifted

Grading is assuming increasing importance in the export trade in logs and lumber.

in part on 15 July 1947, by exempting veneer or peeler logs of grades 1 and 2 and flitches eight inches and over in thickness. On 4 December 1947 sawn lumber became exportable. On 5 June 1948 the export quota was increased from 20 to 50 percent of production.

The first exports went mainly to the United States, China, and Japan. Exports as of 30 June 1948 were 45,000 m^3 (r) (10 million bd. ft.) of logs and 10,600 m^3 (s) (4,490,000 bd. ft.) of sawn lumber and flitches, with an aggregate declared value of more than three million pesos. All export lumber or timber must pass government inspection, using the Philippine grading rules or the National Hardwood Lumber Association grading rules of the United States.

Imports. While Filipino lumbermen were reviving the export trade in logs, flitches, and sawn lumber to the old foreign markets, the Philippines imported durin 1947 (January to October, inclusive), 2,800 m^3 (r) (627,000 bd. ft.) of logs (pine, aspen, redwood, camphor, and lignum vitae) from the United States, valued at P61,848; sawn lumber, 385 m^3 (s) (163,000 bd. ft.) (mostly cedar) from the United States, valued at P340,018; plywood, 324,000 m^2 (3,492,000 sq. ft) from the United States and Mexico, valued at P1,207,082.

Rehabilitation of the lumber industry. To meet present problems of rehabilitation, the Philippine lumber industry should be brought up to an annual production of at least 4.7 million m^3 (s) (2,000 million bd. ft.) as rapidly as possible. This would provide enough for domestic reconstruction requirements and for exports. A cut of this magnitude would still be very conservative, because it would remain considerably below the estimated annual growth of the existing timber stand. The limited financial possibilities and inadequate equipment, however, need to be improved if Philippine lumber is expected to play its part in meeting the world's demands. It is estimated that to achieve this level of production would require an investment of at least P22 million in additional sawmills; P4 millions for finishing mills; P2 millions for veneer mills; P1.5 millions for dry-kilns; P2 millions for wood-preservation treatments; and another million for box and barrel manufacture—a total of P50.5 million.

Of the 342 sawmills established as of 30 June 1948, 312 are actually operating. Only two are reported to have a capacity of as much as 59 m^3 (s) (25,000 bd. ft.) a day. Most of these mills are of the U. S. Army type and are not expected to last long. What is needed is to increase and improve the sawmills and logging equipment in order to build up production and to improve the quality of the products.

Administration of the Philippine Forests

The principle underlying forest administration since 1863 has been the proper protection, delimitation, conservation, and utilization by wise use of timber and timber lands. Under a royal order of the Spanish administration in that year, constructive legislation and regulations were introduced, and investigations were begun, laying the foundation for forestry work in this country. Handicapped though the organizers were in the early days, considerable information was gathered, particularly in the fields of botany, natural history, and utilization. However, the Manila fire of 1897 destroyed the natural history col

lection. When the United States took over in 1900 this information had to be collected all over again. The Spanish laws embraced far-reaching provisions in conservation and protection against human destruction and unwise utilization.

In principle, they were maintained by the newly established Forest Service in 1900 under the American regime and were restated by an Act of 1902 of the United States Congress, which defines the duties and jurisdiction of the Bureau of Forestry insofar as public timber lands are concerned. With little modification, the same Act was adopted by the Commonwealth and later by the Republic. By law, the Bureau of Forestry is given priority in determining what portion of the Philippine public domain shall be retained for forest usage, to be held separate from lands declared to be of agricultural or mineral usage. Under the Constitution of the Republic of the Philippines, ownership of natural resources, including forests, rests with the State.

Present laws and regulations provide for the organization and operation of the Bureau of Forestry under the Department of Agriculture and Natural Resources. The functions, powers, and duties conferred or imposed by law and regulations upon the Bureau of Forestry are performed under the direct control, supervision and responsibility of the Director of Forestry, and exercised through administrative units set out in the accompanying chart.

Office of the Director. The advisory staff, composed of division chiefs and ranking men of the bureau, advises the Director of Forestry in the formulation of policies on administration and management.

The inspection service is handled by division inspectors designated by the Director to supervise the field activities of the bureau and to conduct administrative and technical investigation work that may require immediate or special attention.

The Administrative Division is concerned with administrative functions including personnel, budget estimates, allotment, accounting, collection and disbursements, records, library, supplies and equipment. The preparation of rules and regulations and proposed legislation, as well as the rendering of legal opinions, also come under its activities.

The Division of Forest Investigation is in charge of the research work of the bureau, including the administration of experimental forest nurseries and plantations, plant introduction, and publication of the *Philippine Journal of Forestry.* Investigation work deals mostly with silvics and silviculture, growth and volume measurements of trees and unit areas, establishment of sample plots, study of the influence of forests upon soil, waterflow, and erosion; the identification and classification of trees and woods; study of the chemical, physical, and mechanical properties of wood; and studies on other forest products. Where protection is concerned, studies are conducted on the various agencies destructive to forest nurseries, plantations, forest trees, and forest products as well as on methods of preventing and combating them. The technical personnel of this division also forms part of the faculty of the Forestry School of the University of the Philippines.

The Division of Forest Management is in charge of the preparation of forest working plans for the management of public forests. It handles all questions

Director

I—Advisory Staff

II—Inspection Service

III—Divisions

(a) *Administrative*
1. Public Relations
2. General Service
3. Records
4. Property
5. Legal
6. Stenographers & Typists
7. Accounting

(b) *Forest Investigation*
1. Silvics & Silviculture
2. Forest Products
3. Forest Protection

(c) *Forest Management*
1. Working Plans
2. Forest Claims & Registration
3. Special Uses
4. Game & Wildlife

(d) *Forest Engineering*
1. Forest Reconnaissance and Land Classification
2. Forest Surveys and Maps
3. Forest Improvement
4. Forest Statistics

(e) *Reclamation and Reforestation*
1. Afforestation and Reforestation
2. Cooperative Planting

(f) *Forest Concessions*
1. License Section
2. Special Use Permits

(g) *Sawmills and Utilization*
1. Lumber Grading and Inspection
2. Sawmills and Scaling

IV—Field Service
(a) *Provincial Forest Districts*
(b) *Forest Stations*

of forest land status, including claims and registration, all forms of occupancy and use of public forest lands, the work pertaining to grazing, conservation and administration of game and other forms of wildlife. Also included is the administration of forest reserves, national parks, communal forests, communal pastures, and other special forests.

The Division of Forest Engineering has as its main function the classification and delimitation of public forests so as to separate them from agricultural lands to be turned over to the Bureau of Lands for disposition as homesteads, by sale or lease in accordance with the Public Land Law. The general work of forest reconnaissance, all forms of forest surveys, and preparation of forest maps are handled by this division. The compilation and preparation of statistical data to serve as information and guidance in establishing appropriate policies for the administration of the public forests is also one of the important functions of this division.

The Division of Reclamation and Reforestation takes charge of the reforestation and afforestation of open or grass lands as well as of denuded and logged-over areas which, after classification, are found to be

better fitted for forest use than for agriculture or grazing. It also takes charge of the reclamation of marshlands, sand dunes, and other wastelands. Planting surveys are carried out, especially on critical areas such as watersheds and sources of water supply. The establishment of forest nurseries and plantations and their administration and protection is carried on by this division, which is also directly in charge of the management and administration of the Cinchona Plantation in Bukidnon Province. This division co-operates with municipal, provincial, and city governments in beautification planting and with private individuals and other entities interested in the growing of ornamental forest trees.

The Division of Forest Concessions has supervision over the granting of ordinary and free licenses; over cutting, collection, or removal of timber and minor forest products from the public forests; over the issuance of permits for the leasing of forest lands for special purposes such as sawmill sites, timber depots, hotel sites, bathing establishments, residences, camps, pastures, and for other lawful purposes; and over the issuance of permits for the gathering of orchids and other wild plants. The collection of data on capital investments, on the amount of forest products harvested, and on areas granted, as well as the answering of queries as to location and occupation of public forests, and procedure for securing licenses also fall under the work of this division.

The Division of Sawmills and Utilization is entrusted with the administration of all timber-license agreements; with the scaling of government timber for collection of forest charges; with scaling work requested by private interests; with the grading and inspecting of lumber, logs, railroad ties, and other timbers; with the study of methods of sawmill and logging operations; with the gathering of information on equipment and machinery used in lumbering. It applies provisions of the Executive Order concerning the export of logs and lumber, gathers data on imports and exports, and keeps records of retail and wholesale prices.

The Field Service has 44 provincial forest districts, each headed by a technically trained provincial forester. The number of forest stations in each district ranges from 1 to 12, depending on the extent of forest activities in the province. In all there are 144 forest stations in the Philippines, each under a qualified ranger graduate of the School of Forestry.

Main Assignments

Among the more important activities of the Bureau of Forestry are the following:

Land classification. Public lands are classified as (a) alienable and disposable, (b) timber, and (c) mineral lands. No land of the public domain may be legally disposed of by the Government unless it is classified and certified by the Director of Forestry as not needed for forest purposes.

The basis for land classification work is Section 18, Act of Congress of the United States, 1 July 1902, which reads in part: ". . . no timber lands forming part of the public domain shall be sold, leased, or entered until the Government of said Islands, upon the certification of the Forestry Bureau that said lands were more valuable for agriculture than for forest uses, shall declare such lands so certified to be agricultural in character. . . ." This policy is also set forth in Section 1827 of Act 2711, known as the Revised Administrative Code. In the early part of the American occupation, land classification was limited to individual inspection of areas applied for as homestead, for sale, or for lease under the Public Land Law. In 1919, however, project classification was inaugurated, with 250 hectares set as the minimum limit for a project. Piecemeal classification was continued, nevertheless, and carried on simultaneously with project classification. Land classification has been accelerated since.

Hand-sawing lumber is still practiced in the Philippines, particularly in cutting expensive wood like narra.

The total land area of the Philippine Islands is 29,741,000 hectares, of which 11,871,000 hectares, or 39 percent, had been classified as of 30 June 1948. Of the classified land, 9,957,000 hectares are alienable and disposable lands certified to the Director of Lands as not needed for forest purposes for disposition under the Public Land Law; while 1,788,000 hectares is timberland under the protective and administrative jurisdiction of the Bureau of Forestry; 17,870,000 hectares, or 61 percent of the land area, remains to be classified. It is tentatively figured that about 11,500,000 hectares will be kept as permanent forest area for forest protection, timber production, and other uses of forest lands.

Land classification proceeds as quickly as the funds available permit, in order to provide settlers with agricultural lands, thereby accelerating the economic rehabilitation of the Philippines as a whole.

National Parks Administration. Pursuant to the provisions of Act 3915 of 1 February 1932, there have been proclaimed 33 national parks in the Philippines, containing an aggregate area of 226,142 hec-

tares. The Makiling National Park was the first park proclaimed, 23 February 1933; it covers an area of 5,909 hectares. The latest, the Bataan National Park, proclaimed 1 December 1945 and embracing the Bataan battlefields, contains approximately 31,000 hectares. Sixty proposed national parks are under study.

Forest Reserves. Upon the recommendation of the Director of Forestry, with the approval of the head of the department, forest reserves are set aside by proclamation of the President and "once established shall not be entered, sold or otherwise disposed of, but shall remain as such for forest uses to be administered in the same manner as public forests." There are at present 101 forest reserves throughout the Islands, containing an aggregate area of 1,150,935 hectares. Sixty-eight proposed forest reserves are pending.

Communal Forests and Pastures. Communal forests are tracts of public forest set aside for the use of the residents of a municipality from which they may cut, collect, and remove, free of charge, forest products for their personal use. Communal pastures are portions of public grazing lands to be used exclusively, free of charge, for grazing of livestock raised and maintained for domestic purposes by residents of the municipality. There are 2,096 parcels of communal forests and 94 parcels of communal pastures, containing approximately 284,800 and 19,300 hectares respectively, for the residents of 777 municipalities and municipal districts.

Pasture Lands. There are more than five million hectares of open and grass lands. Some are agricultural lands, others are forest lands. About 1,300,000 hectares are suitable for grazing. Formerly, pasture lands on alienable and disposable areas were leased from the Bureau of Lands, and those in forest areas from the Bureau of Forestry. Under subsequent laws all public land used for pasture has been placed under the jurisdiction of the Bureau of Forestry. In 1941, there were 1,471 pasture permits, covering 119,000 hectares. Because most of the cattle were lost during the war, many cattle owners have not renewed their permits. At present there are only 685 pasture permits covering 66,293 hectares, but 959 applications for permits covering about 311,092 hectares are pending.

Game and Wildlife. The Game Protection Act (2590) was passed February 1916, and in 1932 the Director of Forestry was designated as insular game warden to enforce the Game and Fish Law. In 1939 game and wildlife were placed under the Division of Grazing and Wildlife, Bureau of Forestry. Fisheries are handled by the newly created Bureau of Fisheries. Before the outbreak of World War II, there were 3,688 ordinary hunting licenses and 22 special permits issued, as against 1,283 ordinary and 9 special hunting licenses and permits issued during the fiscal year 1947-48.

Reforestation. One of the major problems of Philippine forestry is the utilization of some 5,270,000 hectares of wastelands, a large portion of which is covered with *cogon* grass, *Imperata exaltada.* This vast area of unproductive land is largely the result of forest destruction by shifting cultivation, domestically known as *kaingin.* During the Japanese occupation, people took refuge in the forest and made clearings to produce food crops. Considerable areas of virgin forests were also destroyed in the course of military operations. The extent of forest destruction caused by the war has not as yet been definitely ascertained. Long before this the Government had realized that forestation would solve the problem of wastelands. Because of financial considerations, work did not go beyond the experimental stage until 1938, when substantial appropriations were granted. These enabled the bureau to open and maintain 35 projects. They had to be abandoned or were destroyed in the course of the war. Rehabilitation of these projects was a grave concern of the Government, which was straitened by loss of its source of funds, the prewar excise tax. Recently, however, the legislature, realizing the urgency of forestation, passed a special tax law providing a reforestation fund, collectible from a small additional stumpage charge for every cubic meter of timber cut from public forest for commercial purpose. This earmarked fund will ensure the continuity of reforestation and afforestation work.

An important activity is the maintenance of the Cinchona Plantation in Bukidnon, Mindanao. In 1941, 358 hectares were planted with 1,200,000 cinchona trees, ranging in age from a few months to five years. Seventy-five percent of the trees were *Cinchona ledgeriana* and the remaining 25 percent were *C. succirrubra, C. officinalis, C. calisaya,* and a hybrid species. Up to that time a total of P257,000 had been invested and the plantation was valued at more than P720,000. During the war the buildings and roads were badly damaged and the records of studies made were completely lost. The plantation itself played a very important role in the fight against the Japanese. It supplied more than 40,000 kilograms of quinine bark to the guerrilla forces and to the Southwest Pacific Command in Australia. About 40 liters of seed was flown from this plantation to America via Australia to start the American cinchona plantation in Costa Rica, which was well launched by the end of the war. Before 1941, more than 23 tons of cinchona bark had been harvested and given to the Philippine Bureau of Science for the manufacture of *totaquina.* Work on the plantation has been resumed and already more than 80 tons has been harvested.

The Forest School

One of the important problems confronting the Bureau of Forestry soon after its organization was the lack of competent technical men. Prominent American foresters like Gifford Pinchot and Henry S. Graves, who visited the Islands, recommended the establishment of a school of forestry to train men for the forest service. In 1910 the Forest School was created as part of the College of Agriculture, University of the Philippines. Originally, it was a training school for forest rangers, who took a two-year course at government expense. In 1916, it became an independent unit of the University of the Philippines, with the Director of Forestry as ex-officio dean. In 1933 the ranger course was abolished and replaced by a four-year collegiate course leading to a degree of Bachelor of Science in Forestry.

Up to 1948, the school had graduated 638 men in the ranger course and 182 with collegiate degrees. Almost all of the technical men in the bureau, around 80 percent of the present personnel, are graduates of the School of Forestry. Twenty-three of these men have taken advanced forestry courses in the United States. They now occupy responsible positions in the

bureau and in the lumber industry. Students from Guam, India, Siam, China, and Borneo have attended this school. The Bureau of Forestry co-operates with the university in the maintenance of the school through the assignment of some of its personnel to the teaching staff and by making available to the school the facilities of the Division of Forest Investigation. For field laboratories it uses the Bureau of Forestry nursery and plantations and the Makiling National Park of about 5,000 hectares.

Although the Philippine Forest Service is quite young, as compared with similar organizations in neighboring countries, its system of forest administration has attracted the attention of foresters all over the world. The Dutch East Indies, China, Siam, India, and other countries have sent foresters to observe it in operation. Filipino graduates of the Forest School have been employed in Borneo and requests for their services have been received from neighboring countries.

Forest Research

At the beginning of the American occupation, investigation work of various kinds was started and carried on by the Bureau of Forestry, in some cases in co-operation with the Bureau of Science and other agencies. In 1902 a timber-testing laboratory and a woodworking shop were established. In 1906 a separate Division of Forest Products was created to investigate the amount, characteristics, value, and uses of Philippine forest products and to bring this information to the notice of Philippine and foreign markets. The work consisted mostly of the preparation of data collected for publication, the classification and cataloguing of reports on hand, the collection of museum samples of forest products, durability tests, and forest investigations. The following year the name was changed to Division of Investigation in view of the increase of the work and of its scope. In 1910 the headquarters of the division were transferred from Manila to Los Banos. This was coincident with the establishment of the Forest School, since the bulk of instruction in the Forest School was and still is handled by the division's personnel.

A considerable amount of research work has been done by the bureau since its organization in various fields pertaining to forestry and forest products, especially in forest botany and dendrology (ecological and systematic), silviculture (in all its phases), forest management (including mensuration, organization, and working plans), forest protection, lumbering and utilization, wood technology.

Major Problems

Forest administration work suffered a great setback as a result of the war. The destruction of laboratories, records, libraries, equipment, wood specimens, and botanical and forest products collections created one of the major problems of the administration. For more than forty years the Forest Service had built up a Forest Products Museum, reputed to be one of the best in the Orient. All of this was destroyed except the original wood samples collection from which the description of types and subtypes had been made. The corresponding botanical specimens, however, were destroyed. Reconstitution of this collection will take time, expense, and effort.

During the war about 50 percent of the trained personnel of the organization served with the armed forces and many of them gave their lives for their country. The gaps in the ranks of the Forest Service have not yet been filled and lack of personnel as well as inadequate funds for travel constitute considerable handicaps to the administration.

The back-to-the-farm movement, particularly of the ex-guerrillas, creates a demand for more crop lands. This is a problem: the Government cannot immediately provide land for occupation; public domain must first be classified and certified by the Bureau of Forestry as not needed for forest purposes before it can be disposed of for homesteads, for sale or lease, and legally occupied. Lack of personnel and appropriations to carry out intensive land classification hinder development planning. "Squatting" or illegal occupancy is frequent and creates a serious problem in forest conservation.

Forest destruction increased after the liberation. Illegal clearings to alleviate the food shortage destroyed valuable forests. On account of the tremendous demand for timber, illegal cutting and timber smuggling became widespread. The great number of unlicensed firearms left over from guerrilla warfare makes enforcement of forest law difficult, especially in the more remote regions.

The lumber industry needs adequate and systematically organized assistance. Although this industry has gone far in rehabilitating itself, still more constructive organization is needed if it is to contribute fully to the reconstruction of the country as a whole and to help supply the rest of the world with lumber and forest products. Financial backing and "know-how" are two important needs.

Research facilities have suffered considerable damage. Loss of equipment and data will require fresh starts on some of the important projects. The School of Forestry must be expanded to train men to carry on the various phases of forest conservation and to provide replacements for the pioneers in forestry, many of whom have now rendered more than 30 years of continuous service and who, because of age and ill health, will soon have to retire. There is a great need for technicians and for adequate laboratory facilities for research in forest products utilization, particularly in the use of waste from logging and lumbering, and in the investigation of new uses for woods which at present are not commercially merchantable.

A number of field experts from FAO and the United States have been sent to help in Philippine rehabilitation. This is particularly true of the fishery resources. It is hoped that similar arrangements can be made for forestry. This could be supplemented by sending promising young men from the Philippine Forest Service abroad to acquire the most advanced knowledge on all branches of forestry, and especially on forest products utilization.

National Situations

In endeavoring to present a background of information for the International Forestry and Timber Utilization Conference for Asia and the Pacific, it was thought useful to include a short summary of comparable data on Asiatic and Pacific countries. These summaries make no claim to be completely authoritative, since data were included only as available, but they do present a condensed sketch of general conditions.

Australia

AUSTRALIA has a land area of over 770 million hectares (1,900 million acres). This is 4 percent forest land, of which some 20.25 million hectares (50 million acres) are classified as productive forest. The population is 7.5 million, so the area per caput of productive forest is 2.7 hectares (6.7 acres). The forest land of Australia is distributed among the States as follows: Western Australia 23 percent, Queensland 22 percent, Victoria 22 percent, New South Wales and Australian Capital Territory 16 percent, Tasmania 12 percent, South Australia 5 percent. These figures exclude a considerable area which contains firewood material only. Of the total productive forest, 13.7 million hectares (34 million acres) are considered accessible. These include 12 million hectares (30 million acres) of broadleaved timber, mostly eucalyptus species, and 1.5 million hectares (3.6 million acres) of conifers, consisting of *Araucaria* or hoop pine, *Callitris* or cypress pine, and a large acreage of *Pinus radiata* and other exotic pine plantations. Publicly owned forests make up two-thirds of the total productive forest area.

Annual growth of all accessible productive forests is estimated at 0.8 m^3 per hectare (12 cu. ft./acre), or a total of 10.3 million m^3 (367 million cu. ft.). This gives a total net annual growth of 8.6 million m^3 (304 million cu. ft.), after subtracting 1.8 million m^3 (63 million cu. ft.) as loss due to fire, insects, and disease. Past average annual fellings were estimated to be slightly over 8.2 million m^3 (290 million cu. ft.), leaving a net balance of almost 400,000 m^3 (14 million cu. ft.) per year. This balance is not as favorable as it appears because the eucalyptus forests are being overcut at the rate of 266,000 m^3 (9 million cu. ft.) per year, while the coniferous forest, especially in the plantations, has a net balance of 656,000 m^3 (23 million cu. ft.) above annual fellings.

To meet its past consumption needs of over 8.8 million m^3 (310 million cu. ft.), Australia imported over 2.2 million m^3 (78 million cu. ft.). These imports came from Canada, 68 percent; New Zealand, 12 percent; U. S., 10 percent; northern Europe, 5 percent; the Philippines, 2 percent; British Pacific Islands, 2 percent; and other foreign countries, 1 percent. Since the war, Australia has been attempting to purchase as much as possible of New Zealand's exports of coniferous timber, which come mostly from *Pinus radiata* plantations in that country. The approximate 0.5 million m^3 (18 million cu. ft.) exported by Australia are principally *jarrah, Eucalyptus marginata,* and *karri, Eucalyptus diversicolor,* which are valuable for railroad ties and dock timbers. These exports before the war were absorbed by New Zealand, 23 percent; United Kingdom, 19 percent; South and East Africa, 16 percent; India and Ceylon, 5 percent; other British countries, 5 percent; Egypt and the Near East, 14 percent; China, 12 percent; and other foreign countries, 6 percent. Before the war, there were over 1,500 sawmills, 23 plywood mills, 18 bark mills, and 35 paper-making plants. In addition, there were almost 3,000 plants engaged in making furniture, wood turning, cooperage, boxes, matches and miscellaneous wood products. All of these plants, including logging operations attached to them, employed over 80,000 people. The principal forest products produced annually before the war were over 2.8 million m^3 (99 million cu. ft.) of sawn lumber for construction, manufacturing and boxes, 350,000 m^3 (12 million cu. ft.) for roundwood (poles and piling), 2.8 million m^3 (99 million cu. ft.) for fuelwood, over 12 million m^2 (129 million sq. ft.) of plywood, over 300,000 tons of paper, of which 25 percent was made up from imported pulp.

Each of the six states is practically autonomous in dealing with forest land. The Commonwealth Forestry Bureau controls or advises on forestry matters in the Australian Capital Territory, the Northern Territory, and Papua, Norfolk Island, and New Guinea. The organization of the forest authority varies by states. In New South Wales, Victoria, Western Australia and Tasmania, Forest Acts define the powers and functions of forest authorities. This is not yet the case in Queensland or South Australia. Since the war, the Director-General of the Commonwealth Forestry Bureau has brought about considerable progress in liaison and co-ordination of forest authorities among the several states.

Research work in silviculture and forest management is the responsibility of the Commonwealth Forestry Bureau and is carried on as an activity of the Australian Forestry School of Canberra. Continuous efforts are made to co-ordinate this work with the silvicultural studies of the individual State forest authorities. One of the outstanding forest products research institutions in the world is the Forest Products Laboratory of the Council for Scientific and Industrial Research at Melbourne. It has done important work in wood structure, wood chemistry, timber physics, timber mechanics, seasoning and preservation, veneers and gluing, and utilization. It has made

important contributions towards modernization of many of the wood-using industries, and particularly the pulp and paper industry of Australia. It has also performed valuable work in standardization of grades and specifications of forest products.

The Australian Forestry School at Canberra performs an important function through the training of badly needed technical personnel. Established in 1925, it now has a teaching staff of eight and an annual student enrollment approaching fifty. It offers a degree of Bachelor of Science in Forestry at the end of a two-year course to students who have passed the approved two-year preliminary science course at the Universities of Adelaide, Melbourne, Sydney, Western Australia, or Queensland. Field work is an important part of the course, including extended studies in the *jarrah* and *karri* areas of Western Australia, the plantations of South Australia, ash-type forest of Victoria or Tasmania, high-country forests in eastern Australia, west-coastal forests of New South Wales, the cypress pine belt, and certain districts in Queensland.

Reforestation has been an important activity in Australia to help make up for the scarcity of native coniferous forests. *Pinus radiata,* native to California, has been planted in many parts of Australia but reaches its best development in South Australia and Victoria. Phenomenal growth rates have been obtained in these plantations. In one case a 30-year-old *Pinus radiata* plantation has yielded 1,120 m^3 per hectare (16,000 cu. ft./acre). Many of these plantations are being handled on a sustained-yield basis. Two large government sawmills and a private paper mill have been installed to keep up with the rapid rate of growth. Stabilized communities have been built around each of the government mills. Plantations of other exotic species, such as the southern pines of the United States, have also been successful, especially in Queensland. During the 1930's, unemployed laborers were used exclusively in nursery and planting work. Displaced persons from Europe are being brought in to provide semiskilled labor in the establishment of plantations.

Fire protection is a serious problem, especially in Victoria, Tasmania, and Western Australia. In 1939 there was a critical fire in Victoria which killed thousands of hectares of valuable eucalyptus forest. Fortunately, a considerable quantity of this timber has been salvaged for use as pulpwood and some of it for veneer.

One of the most important problems is the unsatisfactory condition of much of the eucalyptus forests. In the opinion of Australian foresters, this is due to the period of uncontrolled exploitation by long-established sawmilling interests, low standards of utilization, recurrent fires, and inadequate trained staff. Probably the biggest single need in Australian forests is more effective fire control. Considerable progress has been made along this line since the war.

Among other needs for improving forestry in Australia are: a complete forest survey; development of working plans to adjust present and future industries to growth capacities of the forest; reservation of forest areas for timber production; a large-scale planting program on accessible plantable land for general-purpose softwoods; development of silvicultural management for Eucalyptus forests; the establishment of forest communities on the basis of growth capacity of the forest.

Burma

Fifty-eight percent of Burma's area of 68 million hectares (168 million acres) is forest land. Of this, over 25 million hectares (62 million acres) are classified as productive forest. With a population of 17 million people, this means 1.5 hectares (3.75 acres) of productive forest per caput.

The Irrawaddy and Salween rivers and their many tributaries make possible economic extraction of teak and other forest products to Rangoon and Moulmein, the centers of sawmilling and shipping.

The principal forest types are (1) tidal forests along the coasts, made up principally of several species of mangrove, important for fuel and tanning material; (2) beach and dune forests in narrow coastal flats above high tide limits, consisting of *Casuarina, Hibiscus,* and *Pongamia,* useful as sources of fuel, rope fiber, and turnery products; (3) tropical evergreen forests where rainfall exceeds 300 centimeters in shady valleys, with *Dendrocalamus* and other bamboos, so important for hut building, mats, and baskets, and dipterocarps, *Hopea, Parashorea,* and *Lagerstroemia,* important for structural timbers; and (4) mixed deciduous forests in areas with 100-300 centimeters (40-120 in.) of rainfall in fairly open stands, composed of several species of bamboo, teak, *Tectona grandis,* and the durable *pyinkado* or *Xylia, Terminalia, padauk* or *Pterocarpus,* and *Shorea.* This is the most important forest type in Burma. In addition, there are scrubby forest types in areas with less than 125 centimeters (50 in.) of rainfall producing fuel and hard timber useful for agricultural implements, cart shafts, and ox yokes. These types also include *Acacia,* which produces cutch, an important dye and tanning material. Other types include deciduous dipterocarps in sandy, gravelly, and lateritic soils up to 800 meters' (2,600 ft.) elevation, and small areas at elevations about 1,000 meters (3,300 ft.), of oak, chestnut, magnolia, laurel, and sometimes pure stands of *Pinus khasya* and *Pinus merkusii.*

An important and picturesque element in the forest landscape of Burma is the elephant, which is used like a tractor in logging areas where mechanization would be difficult or impossible. These animals are also extremely useful around sawmills and lumber depots.

The Burma Forest Service, organized by Sir Dietrich Brandis, has developed an excellent system of maps and working plans for all of the teak reserves and a number of other forests. The organization is now headed by a Chief Conservator who is under the Forest Secretary in the Ministry of Agriculture and Forestry. To assist him, he has specialists in utilization, working plans, silviculture, entomology, and economics, and a chief game warden. There are five administrative circles, each in charge of a conservator under whom there were, before the war, some 34 forest divisions, each in charge of a divisional forest officer. Before the war foresters were trained at the University of Rangoon or at British schools, and subordinate personnel was trained at the Ranger school at Pyinmana. There are plans for expanding forestry training in Burma, either at Rangoon or Pyinmana, or at both.

Forest research work was carried out by the Dehra Dun Forest Research Institute in India even after Burma separated from India in 1937. As a result, Burma has yet to build up its own forest research program. Before the war a forest products laboratory was set up to study wood technology, conversion methods, preservation and seasoning (air and kiln), and such minor forest products as lac, cutch, and various drugs. Some work was also done on grading rules for teak.

Forest policy is the same as that for India, based on the original India Forest Act which was taken over at the time Burma was separated from India. Under this policy forests were classified into production, commercial, local supply, and pasture forests. In addition to the forest reservations, there are a number of wildlife sanctuaries and a good system of game protection, even outside the sanctuaries.

The silvicultural system for the teak forests is a group or tree-selection system, which in recent years has been guided largely by diameter limits. Trees are girdled according to the working plan and felled three years later on a 30-year felling cycle. Improvement cuttings and climber cuttings, as well as various measures to obtain natural regeneration, or planting where necessary, are important parts of the system. Another essential part is the *taungya* system of teak planting in combination with crop cultivation. Protection against fire is carried out principally in regeneration areas although the practice of complete exclusion or controlled use of fire are matters of current debate. Teak is considered to be quite fire resistant after it passes the regeneration stage, but deep fire scars are found in many teak logs.

Considerable engineering work has been done in construction of forest roads, trails, and administrative buildings. Another important engineering activity is the training of rivers whereby the heavy silt load of the principal log-driving streams are manipulated so as to create definite channels following a system originated by the Burmese and expanded by the British foresters. Logging has been done by the government in certain working circles, and by private concessionaires in the remainder. As of June 1948, however, all private concessions were nationalized and teak extraction is being taken over by the Timber Project of the Forest Service. Teak logs in the streams are examined at check points to make sure they have a government royalty stamp on them, and auctions are held usually at Rangoon and Moulmein.

Before the war, Burma produced about 710,000 m^3 (25 million cu. ft.) of teak annually. Present production is considerably below this as a result of war dislocation and present uncertainties in the nationalization program. Burma exported annually between 284,000 and 355,000 m^3 (10 and 12.5 million cu. ft.)—mostly as converted timbers, squares, and flitches—to India 75 percent, Europe 20 percent, and to other countries 5 percent. For comparison, India, before the war, exported somewhat less than 2,840 m^3 (0.10 million cu. ft.) of teak, Siam 92,300 m^3 (3.3 million cu. ft.), French Indo-China 18,460 m^3 (0.65 million cu. ft.), and Dutch East Indies 15,720 m^3 (0.56 million cu. ft.).

The world fame of teak is based upon certain outstanding characteristics. It shrinks only half as much as the principal timbers of Europe and America, such as pine, spruce, larch, Douglas fir, oak, ash, elm, beech, and hemlock. It can be worked easily by hand or machine and can be carved beautifully. It peels readily for veneer. Its superiority as a shipbuilding timber has been known for centuries, even back to the time of Nebuchadnezzar. The liner Queen Mary, commissioned in 1936, contains 1,500 m^3 (53,000 cu. ft.) of Burma teak. The wood is useful for decking, gangways, handrails, paneling, and fittings of all kinds; for construction of railway cars, bridges, and sleepers; and for house building, both exterior and interior.

The principal problems in Burma are the filling of vacancies in the Forest Service with well-trained men who will be able to maintain working plans for the teak forests and to develop further working plans for other forests. Modernization of logging and sawmilling are important. Promotion of greater utilization of species other than teak would be helpful. Large-scale soil erosion measures are needed, particularly in the Shan states and Upper Burma.

Ceylon

Ceylon has a land area of almost 6.5 million hectares (16 million acres) of which 55 percent is forest land, slightly over 1 million hectares (2.5 million acres) being classified as productive forest. The population is between 6.5 and 7 million people, so the productive forest area per caput is 0.16 hectares (0.40 acres).

All forest land is State owned and consists of dry mixed evergreen and wet zone forest types. Estimates of standing timber place the total at almost 141 million m^3 (4,980 million cu. ft.), of which 20 per cent is of sawtimber quality and 80 percent of fuelwood size.

Among the important products are satinwood, for high-grade furniture, *Campnosperma* and *Doona*, useful for veneers for tea-chests. In addition, Ceylon produces bamboos, canes, tanbark, and dyestuffs. In 1944 Ceylon imported 11,500 m^3 (406,000 cu. ft.) of timber to augment its own production of 64,000 m^3 (2.3 million cu. ft.) to give a total consumption of 75,500 m^3 (2.7 million cu. ft.). Ceylon was, however, self-sufficient in fuelwood, consuming an outturn of 235,000 m^3 (8.3 million cu. ft.). The estimated annual increment was 252,000 m^3 (8.9 million cu. ft.) of fuelwood and 60,000 m^3 (2.1 million cu. ft.) of sawlog size.

Ceylon's forest policy seeks to make the country self-supporting in timber and fuel by systematic exploitation of existing resources and by artificial reforestation of selected areas. It provides further that all forest areas over 1,700 meters (5,600 ft.) in elevation are to be regarded as protection reserves and not as economic forests. It also provides for planting the *patnas*, or grasslands, at this elevation.

Considerable effort has gone into co-operative reforestation projects with teak and *jak*, *Antocarpus*, *Acacia*, and eucalyptus. Work has been done in enumeration as a basis for developing working plans for reserve forests. At present over 250,000 hectares (620,000 acres) are under plans for improvement felling, teak working, commercial felling plantations, or conversion fellings. Over 800,000 hectares (2 mil-

lion acres) are not yet under working plans. There are 28,000 hectares (69,000 acres) under natural regeneration and 800 hectares (2,000 acres) in plantations.

According to working plans in the dry-zone forests, which supply all the primary hardwoods suitable for sleepers and building construction, there is a surplus of increment over exploitation and loss. This surplus amounted to 37,000 m^3 (1.3 million cu. ft.) in 1947. The wet-zone forests, however, which supply secondary hardwoods, plywoods, and box woods, were over-cut by about 3,700 m^3 (130,000 cu. ft.) above annual increment. There is thus a net gain of growing stock for the country as a whole, exclusive of climatic reserves and inaccessible areas, of 33,300 m^3 (1.2 million cu. ft.)

As a result of the war, there has been an expansion in construction of access roads into previously inaccessible forests. There has also been an increased use of locally produced timber as substitutes for teak and other imported species. The wood-using industries use 50 circular saws, 4 band saws, and 16 frame saws, which together have a potential capacity of 85,000 m^3 (3 million cu. ft.). Shortage of timber because of transport difficulties and present supply of logs cannot keep more than 60 percent of this capacity in operation. One plywood plant operated by the government produces over 370,000 m^2 (4 million sq. ft.) of tea-chest plywood. A new privately owned plywood factory has a capacity of almost 46,000 m^2 (500,000 sq. ft.) of tea-chest plywood.

The Forest Department in 1946 consisted of 11 European forest officers in the senior category, 8 intermediates from Ceylon, and a subordinate field staff of 240. Facilities for research, which have in the past emphasized silviculture and forest management, may be expanded through the establishment of a central research institute. This could include new research into timber utilization on such immediate problems as seasoning, grading, charcoal production, saws, and preservation. The possibility of combining such a research institute with the establishment of a forestry school should be carefully considered. In the past, rangers and guards have been trained at the Coimbatore and Dehra Dun ranger schools in India, but the Forest Department has recommended a domestic school.

The Forest Department also recommends that crown forests now under the administration of revenue officers should be placed under the protection and management of the Forest Department.

China

Of China's 944 million hectares of land, less than 9 percent—or 83 million hectares—is forested. Of this, 56 million are classified as productive forest, which means that with a population of over 455 million there is only 0.12 hectare of productive forest per caput. The forest is classified as old growth—29 million hectares with an estimated timber reserve of less than 5,000 million m^3; and second growth forest of almost 54 million hectares bearing less than 3,000 million m^3. It is estimated that more than 230 million hectares of denuded mountain slopes and wasteland are suitable for reforestation. The national and provincial governments own about 90 percent of the old growth and only 5 percent of the second growth forest. Private owners hold the balance. The national and provincial governments own 60 percent of the denuded mountain areas, the remainder being held by private owners and communities.

The distribution of the natural forests in China is as follows:

The southwest region — provinces of Szechwan, Sikiang, Yunnan, Kweichow, and Kwangsi—has almost 16 million hectares of fir, spruce, pine, *Cunninghamia*, oak, camphor, and liquidambar.

The northeast region—Manchuria—has over 45 million hectares of fir, larch, pine, birch, aspen, and oak.

The northwest region — provinces of Kansu and Ninghsia — has almost 7 million hectares of spruce, *Thuja*, juniper, elm, birch, and aspen.

The southeast region — Formosa, Hainan Island, Hunan, and Kwangtung—has over 4 million hectares of *Chamaecyparis*, pine, *Cunninghamia*, hemlock, oak, and camphor.

Central China—provinces of Shensi and Hupeh—has over 4 million hectares of spruce, hemlock, pine, poplar, walnut, and chestnut.

Of high economic importance are the bamboos, *Phyllostachys* and *Bambusa*, which occur widely distributed in the Yangtze and Pearl river valleys.

A large share of the privately owned second-growth forests occurs as farm woodlots, usually on the rolling lands such as those south of the Yangtze Valley. These woodlots have been an important source of fuelwood, the supply of which is one of the most urgent problems in China. In many of the rural areas these rolling lands are devoted to grass, which is cut for fuel. In order to obtain fuel, the people often cut down young forest plantations before they have a chance to grow. Protection of such plantations has, therefore, been most difficult.

The timber requirements have been roughly estimated at 45 million m^3. The annual cutting is about half of this amount so that large imports are necessary to make up the remainder. Forest products industries registered with government agencies so far include 24 sawmills, 1 plywood factory, 20 match factories, and 14 furniture and wood-turning plants.

Early in the history of the Chinese Republic, forest legislation was enacted. In 1940 the various government agencies concerned with carrying out such legislation were brought together into the Department of Forestry and the Bureau of Forest Research in the Ministry of Agriculture and Forestry. Considerable work has been done in reforestation and in research. Special activities have included the establishment of sand-blow control forests in the Yellow River flooded areas, and the supply of building materials for the Ministry of Communications in its transportation development program.

There are 10 universities giving forestry instruction and 20 vocational schools of agriculture which also teach forestry. The forestry graduates, who number almost 400, find difficulty in obtaining employment because the national budget provides only a small amount of money for forestry work.

Principal problems include (1) expansion of reforestation efforts, (2) development of transportation facilities to reach old-growth timber, (3) bringing in modern logging equipment and sawmills, and

(4) above all an increased concern on the part of the government for an adequate forest conservation program.

Fiji

Fiji is a British crown colony of more than 300 islands, about one-third of which are inhabited. Of a total land area of somewhat over 1.8 million hectares (4.4 million acres) over one-half or approximately 957,000 hectares (2.4 million acres) are covered with forest, all classified as productive, including about 20,000 hectares (50,000 acres) of mangrove forest which lie below the high water mark. The population is 300,000, so productive forest per caput is 3.2 hectares (8 acres). Of the two main islands, Vitilevu (on which the capital, Suva, is located) is about 50 percent forested, and Vanualevu is about 60 percent forested. The islands are rugged and mountainous, with the highest point over 1,200 meters (4,000 ft.) above sea level. The underlying rock is mostly volcanic in origin. Most of the islands are surrounded by barrier reefs which usually have openings opposite the river mouths, an important factor in shipping material into Fiji or forest products out of Fiji.

Due to the prevailing southeast trade winds, the southeast sides of the islands have a rainfall of about 325 centimeters (130 in.) a year and carry tropical rain forest. The lee side of the islands has a rainfall of about 175 centimeters (70 in.) and contains some rain forest but mostly reed-covered plains. Hurricanes occur in the months of November and April. Fiji is an important cable station in the Pacific, but internal communications are not well developed. Travel from the coast into the interior is difficult and consists almost entirely of footpaths, some of which are wide enough for horse travel.

Despite the traditional dependence of the people on timber for house-posts, canoes, house utensils, spears, ropes, cloth, and gum for torches, large areas of forest were destroyed by the system of shifting cultivation. Sandalwood was an important factor in the settlement of the islands, and its careless exploitation has led to its almost complete extinction. Heavy cutting of mangrove and other species in the vicinity of Suva and the spread of erosion in many of the plantation areas aroused sufficient concern to bring about the passage of a Forest Ordinance in 1913 authorizing the governor to set aside reserved forests. Unfortunately, the few areas thus reserved were not protected or patrolled. In 1927 it was proposed to establish a Forest Department and to enact new forest legislation providing for a system of reserved forests, forest management and research to make Fiji self-supporting in timber. In 1937 this department was created.

The forest types of Fiji are mangrove forest, beach forest, and rain forest. In nearly all forest types the commercially valuable species are widely scattered. Much of the inaccessible inland forest has been seriously degraded by shifting cultivation. The principal local timbers include primary hardwoods: *Eugenia* spp., *Intsia* sp.; general utility—*Agathis* sp., *Calophyllum* spp., *Podocarpus* spp.; special utility — *Bassia* sp.; *Dacrydium* spp.; ease woods—*Endospermum* spp., *Myristica* spp.; and firewood—*Rhizophora mucronata, R. mangle.*

As to ownership, 90 percent of the forest land is held by Fijians, largely in the form of tribal or family holdings, varying in size from 0.40 hectares (1.0 acre) to 400 hectares (1,000 acres). Complete approval by the family or tribe is necessary before any action can be taken on such land. The Crown owns comparatively little land, mostly in the form of small catchment areas, a few scenic reserves, and all mangrove forest.

Timber consumption figures indicate that of the almost 42,500 m^3 (1.5 million cu. ft.) of timber used, 16,000 m^3 (0.6 million cu. ft.) were locally produced and the remainder was imported; over 23,000 m^3 (0.8 million cu. ft.) of fuelwood were produced locally. These figures are exclusive of forest products taken for domestic use by the inhabitants without payment. The colony therefore in 1938 produced less than 60 percent of its own requirements. There are six sawmills and a number of handsawing pits. Most of the sawmills log their own concessions, either on Crown land or on Fijian land. Extraction is done by ground-skidding, using cables and steam winches. Logs are then moved to the mill on small trucks hauled by tractors mounted on wooden rails. Royalty is collected on the basis of the sawmill measurement of lumber produced. Control of cutting consists of partial enforcement of a minimum diameter limit, usually 45 centimeters (18 in.). Some of the sawmills, mostly of Indian ownership, use logs purchased from individual loggers who make private agreements with the Fijian owners.

Fuelwood production is almost entirely made up of mangrove. Although some revenue is collected from these operations, there is little or no control of cutting. Most of the rural population obtains its fuelwood by indiscriminate cutting wherever it can. Although most agreements under which logging is done contain clauses for reforestation, there is little observance of such requirements.

Some experimental work has been done in plantations of exotics, including a number of conifer species from the United States. Work was also done on silvicultural treatment to obtain natural regeneration, as well as obtaining volume table data, collection of herbarium material, and the testing of certain species for paper pulp and match production, testing of various types of charcoal kilns, and the introduction of shingle-splitting. The principal problems include adoption of a forest policy, establishment of a system of forest reserves, initiation of silvicultural improvement work in these reserves, establishment of plantations in the dry zones, recruitment and training of a staff, and development of botanical, silvicultural, and forest-products research.

Hawaii

A territory of the United States, Hawaii has a total land area of over 1.5 million hectares (3.5 million acres), which is 46 percent forested, all classified as productive. The population is 500,000, and the per caput productive forest area is 1.5 hectares (3.7 acres). Of the productive forest area, less than 450,000 hectares (1.1 million acres) of mixed dipterocarps are considered accessible. The 40 percent of the forest area which is publicly owned is handled as protection forest. The remaining 470,000 hectares

(1.2 million acres) is in private ownership and produces small amounts of logs for the four sawmills in the Islands.

Watershed protection and recreational use are the principal functions of the publicly owned forest land. The valuable pineapple producing areas on the level land place a high premium on the protective influences of the forested slopes. During 1947, 100 hectares (250 acres) of cut-over land which had been damaged by grazing and by fire were reforested, using species tested at arboreta located at various climatic stations throughout the territory. Forestry work is under the direction of a territorial forester with a very small staff.

India and Pakistan

Owing to the absence of separate statistics since partition in 1947, information on India and Pakistan is presented together. Of the land area of over 222 million hectares (550 million acres), some 20 percent is forest land. The area under effective control of the Forest Department is between 13 and 14 percent of the total land area. The population of the areas now in Pakistan was in 1941 over 70 million people, with an average density of 80 people per km^2 (200 per sq. mi.) but which ranges from 300 per km^2 (780 per sq. mi.) in eastern Pakistan to 35 per km^2 (90 per sq. mi.) in western Pakistan. The provinces and states making up India had in 1941 a population of over 314 million people, with an average density of over 106 per km^2 (275 per sq. mi.). Kashmir, about which no decision has yet been reached, has over 40 million people with an average density of 19 per km^2 (49 per sq. mi.), and a forest area of over 2.5 million hectares (6 million acres). Taking India, Pakistan, and Kashmir together, this means roughly a per caput productive forest area of just over 0.1 hectare 0.25 acre).

The forests are distributed in the lower slopes of the Himalayas, the eastern hill ranges near the Burma border, the lower hill ranges in central India, the edge of the Chota Nagpur plateau, the Western Ghats and other hill ranges.

The Himalayan forests are essential for the protection of the Ganges Valley against erosion and floods. But they are especially important because the densely populated Ganges Valley and much of the northern Indian Plains are almost destitute of forests to supply villages with fuel and small timber. In the Sind and Punjab in western Pakistan the absence of forests is considered to be an important factor in the gradual drying out of the country. Much of the deteriorated condition of privately owned forests, which make up almost 30 percent of the total, can be traced to early and continued wasteful exploitation methods of cutting for railroad ties, construction lumber, and fuelwood. Even now the well-organized Indian Forest Service does not have sufficient authority to control adequately cutting practices on private land.

In 1878, the Indian Forest Act was set up with the following objectives: (1) maintenance of forests to preserve favorable climatic and physical conditions; (2) preservation of the minimum area of forest needed for the general welfare; (3) agricultural use must be given preference over forestry; (4) needs of the local population for wood, free, low prices, has priority over (5) securing the greatest possible revenue, but only after the first four objectives have been met. Accordingly, government forests were classified as protection reserves to prevent floods, erosion, or desiccation; timber forests for industry and export as revenue producers; minor forests to meet needs for fuel and small timber; and pasture forests. Forest working plans were drawn up at an early date and were placed on a scientific basis after 1918 for government reserves. Only part of these reserves, however, have received adequate protection to prevent their deterioration, which in some cases is similar in degree to that of private forests.

In the year 1944-45 a total of 9 million m^3 (320 million cu. ft.) of wood was produced from government forests. Of this amount, only 200,000 m^3 (7 million cu. ft.) were softwoods; the remaining 8.8 million m^3 (313 million cu. ft.) were hardwoods. Fuelwood and charcoal wood made up over two-thirds of the total production. This, of course, represents a serious overcut according to the sustained annual yield capacity estimated before the war. However, it is felt that the Forest Service can, with careful management, bring the forest back to normal yield within ten years. The output of plywood, which was greatly increased during the war, dropped with the closing of a number of factories. India consumes over 7.5 million m^2 (80 million sq. ft.) of plywood for tea chests alone and could use a great deal more for all purposes. The present capacity of factories, if properly managed, is estimated to be over 9 million m^2 (97 million sq. ft.) of plywood. Efforts to meet the need for training plywood technicians are being made by the Forest Research Institute. Total consumption of all wood in India is estimated to be about 0.03 m^3 (1 cu. ft.) per caput per year, but with a slight increase in purchasing power it is estimated that effective demand could be six or eight times this amount. To achieve this, it would be necessary to improve extraction methods, utilize species now considered "jungle woods," make greater use of wood waste from logging and sawmilling, and improve the growth of existing forests. A Paper Panel set up by the Government of India is making plans for the development of a paper and paperboard industry. Plans are also under way for increasing the production of rayon and cellophane. In addition to softwood pulp, such industries would require supplies of bamboo and grasses.

There is excellent provision for training professional forest service personnel at the Indian Forest College at Dehra Dun, with an annual capacity of 60 students; ranger-type personnel are now trained at the Central Rangers' College in Dehra Dun with an annual capacity of 110 students, or at the Rangers' College at Coimbatore, with an annual capacity of thirty. In addition, several of the provincial governments have plans for forestry training at agricultural schools for personnel below the ranger grade. Pakistan has plans for setting up a Forestry School at Murree. Forest research is centralized at the Dehra Dun Forest Research Institute; some provinces maintain research sections in their forestry organizations for silvicultural studies which receive guidance on a voluntary basis from Dehra Dun. The

institute has done remarkable work in dendrology, silviculture, entomology, wood chemistry, minor forest products, cellulose and paper pulp, wood technology, wood preservation and seasoning, woodworking and timber mechanics.

Among the present problems are: (1) the supply of fuelwood to villagers for domestic needs (to overcome the burning of dried cow dung, which is vital as fertilizer for farmland) and of small timber for farm implements and housing; (2) the control of eroding lands by large-scale measures to stop wind erosion in the dry areas and soil washing and floods in the areas of heavy precipitation; (3) special legislation to control wasteful cutting on private land; (4) the development of farm forestry, although the tremendous pressure of heavy population makes this very difficult.

Indo-China

Indo-China has a land area of almost 67 million hectares, of which about 51 percent, or almost 34 million hectares, is forest land distributed among the five provinces as follows: Tonkin, 5.5 million (47 percent forested); Annam, 6 million (40 percent forested); Cochin, 2 million (33 percent forested); Cambodia, 10 million (66 percent forested); and Laos, 10.5 million (55 percent forested). Population before the war was in the neighborhood of 25 million, which means a per caput forest area of 1.4 hectares.

In southern Indo-China, comprising Cambodia, Cochin, southern Annam, and southern Laos, the forests consist of mangrove along the coast and swampy areas, mixed dipterocarps and leguminous species at the lower elevations, and *Pinus merkusii* and *Pinus khasya* above 1,000 meters' elevation, and in some places of mixtures of dipterocarps and *Quercus*. In a few localities there are mixtures of coniferous *Dacrydium* sp. and *Podocarpus* sp. In northern Indo-China, consisting of northern Annam, northern Laos, and Tonkin, there are mangrove forests along the coasts and swampy areas, mixed dipterocarps and leguminous species as well as *Quercus* at the middle altitudes, and *Podocarpus*, Chinese fir, *Cunninghamia*, hemlock, *Abies*, and *Cryptomeria* at the higher elevations.

There are no estimates of volumes except on individual reserves, which are under the close supervision of the Department of Forests and Waters. On these reserves, work has been done in the development of management methods especially for the dipterocarps and for turpentine production in the pine stands. Exploitation before the war was not done very systematically, and, since the war, military and political conditions have been so unsettled as to prevent the carrying out of plans which would improve the situation. In 1941, total production of timber was almost 900,000 m^3 and 1.75 million m^3 of firewood. Before the war, the principal production was in the hands of Chinese and Malayans, with only a few European operators. Methods of production vary in the provinces. For example, in Cambodia 10-meter-length logs are produced; in Tonkin log lengths are 4 to 6 meters, and in Annam 2 to 8 meters. Transportation from the stump to the road or river is by wooden carts hauled by oxen, and in some cases by tractors or elephants. Logs are then hauled by truck or floated or towed down the rivers to sawmills and markets. The Mekong is the principal river for log transport. Although no teak is produced in Indo-China, a considerable amount of teak logs comes down the Mekong River from Siam, and is sawed in Saigon mills.

The lumber industry before the war consisted of 10 European sawmills and a large number of small local and Chinese sawmills, furniture plants, match manufacturers, building contractors, and woodpulp producers. There is also an unknown number of hand-sawing pits. During the Japanese occupation, the sawmills were combined under Japanese control and all timber felling and lumber production was under their supervision. Since the war, unsettled conditions have greatly disrupted the sawmill industry, especially European-owned mills. The French Government has initiated government exploitation and sawmilling through an organization known as SOCAFOR. Under its direction, modern equipment is being brought in on several important logging operations and sawmills, especially in Cambodia and Cochin.

Before the war, there were six important match factories which produced annually almost 500 million boxes of matches. There is one important veneer and plywood factory at Saigon. Before the war there were five woodpulp factories using softwood and bamboo. Annual production of paper at one time reached almost 1,000 metric tons. There is also important production in furniture, boat-building, and railway ties.

The Department of Forests and Waters was patterned after the forest service of Metropolitan France. It was made up of graduates of the *Ecole Nationale des Eaux et Forêts* at Nancy. As a result of unsettled conditions since the war, almost the entire staff has been brought into Saigon, with a few men still working in Cambodia. A recent development is the use of locally trained foresters under the guidance of French foresters. There are plans for sending two local foresters to Nancy for training each year. Training for ranger-type personnel is also provided at Pnompenh.

Research accomplished before the war included important contributions in botanical descriptions and mechanical testing of the principal timber species of Indo-China. Unfortunately, the laboratory and the equipment near Saigon have been completely destroyed. Anticipating the settlement of present political difficulties, French foresters have plans for expansion of their work, including the construction of badly needed roads on a systematic basis into previously unexploited areas. They also hope to modernize the lumber industry and to expand the turpentine and rosin industries. There is a need here as in other countries of the region for the standardization of lumber grades and specifications. There is also a need for construction of dry kilns and the adoption of improved seasoning and preservation methods. There are also plans for converting low-value mixed dipterocarp forests into teak plantations following the *culture intercalaire* system, which is similar to the Burmese *taungya*. Considerable work has also gone into reforestation with other species, and there are plans for expanded work in this direction.

Indonesia

The forest area of Indonesia is estimated to be 120 million hectares, with a productive forest area of about 70 million hectares and the remainder almost entirely protection forests. The population is over 75 million, giving a per caput productive forest area of 0.93 hectares. Statistics for Indonesia are usually divided to cover Java and Madoera in one group, and in another group the remanider of the islands, consisting of Sumatra, Borneo, Celebes, Soenda Islands, Moluccas, and western New Guinea.

Java and Madoera: Twenty-one percent of the area is forested, making a total of 28,000 km^2 of forest land. Before the war, there were over 8,000 km^2 of almost pure natural stands of teak, *Tectona grandis*. Exploitation of teak has been highly developed because its great value has justified the construction of narrow-gauge railways and roads from the forests to cities and coastal ports. Forests other than teak covered 23,000 km^2 before the war, but some 3,000 km^2 were destroyed during the Japanese occupation. The teak forests cover the lower slopes in eastern Middle Java. Other forests are principally confined to the mountain tops and upper slopes, where they serve the important purpose of protecting water supplies for the irrigated rice cultivation.

The forest policy has two principal objectives: (1) economic production of timber and other forest products, and (2) improving wherever possible the water, soil, and climatic influences of the forests. Since 1860 there has been an organized Forest Service which consists of 50 forestry sections concerned principally with productive management of teak. This has included the very carefully developed system of clearing natural forest for charcoal, fuelwood, and other forest products. In these cleared areas local people cultivate crops between rows of planted teak. This continues for several years until the teak saplings shade the ground; the people then move to other areas, and the process is repeated. Production before the war reached 500,000 m^3 of teak timber, partly in the form of thinnings, and 1 million stacked meters of firewood. In the non-teak forests before the war there were produced annually 45,000 m^3 of timber and 280,000 stacked meters of firewood; in addition some 20,000 tons of charcoal were produced from both kinds of forests. There were, before the war, some 64 sawmills. The exact number now operating is not known.

The Other Islands: The other islands have a much larger forest area, almost 1.25 million km^2, or 68 percent of the total land area, and the density of population is much lower than in Java and Madoera. The forests consist of about 500,000 km^2 of mountain type and of over 700,000 km^2 of lowland forests, including dry land, marsh, and flood forest types. In an effort to overcome the prevalent roving agriculture, forest reserves have been set up by the Forest Service. Except for small stands in South Sumatra and on the islands of Moena and Boeton, there is no teak in this part of Indonesia. The forest consists principally of dipterocarps in the west, and of *Agathis* and eucalypts in the eastern part. In northern and middle Sumatra are found mixed and pure stands of *Pinus merkusii*. The pure stands occur in areas of frequent forest fires resulting from roving agriculture. Prewar activities in rosin and turpentine production have not yet been resumed. *Pinus merkusii* has been used successfully for reforestation purposes in Sumatra, Celebes, the Lesser Soenda Islands, and Java. The lowland forests, which are close to the coast or along navigable rivers along the northeast coast of Sumatra, adjoining the Straits of Malacca serve as a principal source of timber, especially for softwood production. Chinese operators using Chinese labor produce most of the logs. These logs, as well as the fuelwood and charcoal from mangrove flood forests, were shipped mostly to Singapore. Since the war, exploitation has been developed along the south coast of Borneo. An important problem here, as in other parts of the region outside Java and Madoera, is the shortage of labor. Recent tests of logging machinery to help overcome this shortage have proved successful in most cases. Production before the war was estimated at 1.3 million m^3 of timber, 1 million stacked meters of fuelwood, and 290,000 tons of charcoal. There were 82 sawmills before the war. Other forest products, of considerable value, include rattan, resins, and gums. Among the resins is copal, from *Agathis*, used in the paint industry, and among the gums is jelutong, derived from *Dyera*, used in chewing gum.

The Forest Experiment Station at Buitenzorg, which before the war did important research, has resumed its activities, especially in the management of forests other than teak in the Outer Islands. Noteworthy botanical and dendrological work has been done by this station in conjunction with the Botanical Gardens at Buitenzorg.

Dutch foresters making up the Forest Service have usually been graduates of Wageningen University. Domestic ranger-type training is to be provided for the Indonesian personnel.

Japan

The four main islands of Japan have a land area of 37.5 million hectares which are almost 60 percent forested, giving a total of over 22 million hectares of productive forest area. The population exceeds 75 million, and the productive forest area represents 0.3 hectares per caput. More than 19.5 million hectares are classified as accessible and consist of 5.5 million hectares of conifers, mostly plantations, almost 10 million hectares of hardwoods, and over 4 million hectares of mixed types. Ownership is divided about half and half between public and private owners. Estimates place total volume of all species at 17,225 million m^3 with 645 million in conifers and 579 million in hardwoods. The corresponding figures on a per-hectare basis are 62 m^3 for all species, 83 m^3 for conifers and 48 m^3 for hardwoods. Growth on the accessible productive forest area is estimated to be 40.5 million m^3 per year or 2 m^3 per hectare.

In 1947 there were 34,000 sawmills in operation consuming 11.6 million m^3 of sawlogs and 320 plywood mills producing over 16 million m^2 of plywood. There are more than 100 pulp-producing and 300 paper-producing companies in Japan, but 85 percent of the pulp is produced by six companies, and 65 percent of the paper is produced by one company. Repair of war damage continues to require more than the productive capacity of all the sawmills.

Railroad ties, mine timbers, and pulpwood are also in short supply.

Long noted for its active reforestation work both for watershed protection and for timber production, Japan has expanded its plans for forest nursery and planting programs. In 1947 over 400,000 hectares were reforested. Systematic forest working plans have been prepared for the almost 8 million hectares of nationally owned forests and progress is being made in the extension of working plans to private forest land. The Bureau of Forestry, Ministry of Agriculture and Forestry, has consolidated forestry work in the 47 provinces, the imperial forests, and in the national forests. Forestry research is carried out by the experiment stations of the Bureau of Forestry, of the Imperial Household, and of a number of provinces. Most of the work has dealt with reforestation methods and dendrology, but some has been done in wood technology. It is hoped to expand research work in the field of products utilization. Forestry education is provided through forestry schools at the four Imperial Universities and at 17 provincial agricultural colleges. The principal problems facing the wood-using industries include restoration of transportation facilities and supplying certain raw materials, such as glue, to the plywood industry and coal and chemicals to the pulp and paper industry.

Korea, Southern Portion

Data available on the portion of Korea south of the 38th parallel indicate that 40 percent of the total land area of 16 million hectares is forest land. Half of this forest area is poorly stocked and in need of replanting. Rough estimates place the volume of timber at 300 million m^3. Growth is estimated to be slightly over 12 million m^3 per year. Because much of this growth is on very small trees, it will not be usable for some time to come. The calculated allowable cut on a sustained-yield basis is estimated at about 7 million m^3. With a population of 15 million, southern Korea has 0.4 hectares of forest land per caput. The minimum wood requirement is estimated to be 17 million m^3 per year, which results in a forest land allocation of 44 percent for the production of firewood and charcoal, 30 percent for sawmill production, and the remainder for erosion control and watershed protection. One-quarter of the forest land is in public ownership. The forest types consist of red pine, *Pinus densiflora*, Korean pine, *Pinus Koreaensis*, oak, larch, spruce, fir, and mixed hardwoods.

The forestry services have been reorganized with Korean foresters. In the Department of Agriculture and Forestry, the Director of Forestry with his small headquarters staff in Seoul has jurisdiction over forestry organizations in the eight Provinces.

In 1947, 800 sawmills produced almost 600,000 m^3, or 40 percent of the rated capacity; three plywood factories produced almost 420,000 m^2 of plywood; 14 paper mills produced over 3,000 metric tons. Firewood, charcoal, pulpwood, cork, tannin, lacquer, and resin are among the principal products of the forest.

In an effort to meet the reforestation needs of southern Korea, at one time set at 275,000 hectares per year, nurseries have been established with the object of producing 200 million trees. In 1947 the nurseries produced about 100 million. An important problem in connection with this reforestation program is the protection of the plantations through the enactment and enforcement of legislation. Lack of such protection has resulted in the destruction of many plantations, which were established during Japanese control. Research is carried on at the Forestry Research Station near Seoul. Studies have centered around reforestation methods, storage of seed, growth rate of trees, and strength of wood. Many of the prewar records have been destroyed. Experimental Forest Stations have been set up in each province. Before the war, forestry degrees were granted at the Colleges of Suigen and Taikeyu and all the middle schools in southern Korea have forestry courses.

The chief problem facing the forest services is that of attaining adequate government support for the recruitment of trained personnel, and for the work it will have to carry out.

Malaya

Malaya has a land area of 13.5 million hectares, 77 percent of which is forested. Of this, 7.3 million hectares are classified as productive forest. The population numbers almost 6 million, so the per caput productive forest area is 1.25 hectares. Considerable work has been done on botanical description and on technical properties of the important Malayan timbers. The forest types consist of mangrove along the coast and swampy areas, and mixed dipterocarp forests, with *Shorea* sp. in the hills.

Exploitation of commercial timbers is well organized and carefully supervised by the Department of Forestry. At the end of 1946 there were in operation 4 match factories and 110 sawmills, the latter producing almost 500,000 m^3 of lumber that year. One modern plywood mill, producing tea chests and wall panels, went into full operation in 1948. Malaya is a timber exporter and all shipments that go through Singapore must be inspected and graded by the forest officer at Singapore.

Progress is being made at Singapore in the development of grading rules that will be satisfactory to importers in the United Kingdom and other European markets, as well as in the Western Hemisphere. The important wood technology studies of the Forest Research Institute at Kepong near Kuala Lumpur have been of great value in the development of these grading rules. The Institute has also done considerable work in silviculture and management of the mixed dipterocarp forest types. The Forestry Department at present consists of 40-odd British foresters in charge of the forest reserves, assisted by about 20 local foresters trained at the vernacular school at Kepong. In addition, there are five British foresters at the Forest Research Institute.

The tin-mining industry is an important user of locally produced timber. The rubber industry, which is also highly important in Malaya, is endeavoring to obtain permission from the Forestry Department for the clearing of more forest land for new rubber plantations.

Among the outstanding problems involved in the expansion of Malaya's timber production are a better understanding of market requirement by producers; standardization of lumber grades and specifications;

high ocean freight rates; shortage of labor, which has been aggravated by current political difficulties; modernization of worn-out sawmill machinery; the construction of roads into previously inaccessible forest areas; general adoption of modern methods of seasoning and preservation of timber.

New Guinea and Papua

These territories are under the administration of the Department of Forests of the Territories in conjunction with the Commonwealth Forestry and Timber Bureau of Australia. They have a land area of over 46 million hectares (115 million acres) about equally divided between Papua and New Guinea. Together they are 60 to 70 percent forested. The population is in the neighborhood of a million. Forest types include the lowland rain forest from sea level up to about 700 meters (2,000 ft.) elevation. The midmountain forest consists of *Araucaria* and oak; and the mossy forest at 2,300 to 3,500 meters (7,000 to 11,000 ft.) elevation is composed of *Nothofagus, Phyllocladus, Dacrydium, Libocedrus,* and *Podocarpus.* There are also some swamp forests and savannah types of little economic value except for mangrove. The lowland rain forest resembles the mixed dipterocarps of Indonesia, the Philippines, Indo-China, and Malaya. The *Araucaria* resembles that of northeastern Australia, and the mossy forest is similar to the indigenous type of New Zealand.

The ownership of forest land remains with the inhabitants either as individuals or as village groups. Government ownership must be obtained through purchase from the inhabitants before territorial forest reserves can be established.

There has been extensive coverage of the territories by aerial photographs taken during the war. There has also been considerable botanical collection and classification work by the Australian Forest Products Laboratory of the Council for Scientific and Industrial Research at Melbourne, and by the state botanist of Queensland in Australia. There are, however, only very rough estimates of the volume of timber in the territories. Such estimates place the rain forests at 38 to 114 m^3 log volume per hectare (640 to 1,630 cu. ft. per acre) and the *Araucaria-oak* forest is said to carry about 1.1 million m^3 (40 million cu. ft.) over a total area of 15,000 hectares (37,000 acres). During the war, U. S. Army sawmills produced considerable quantities of lumber. There are now 11 sawmills operating which in 1947 produced about 21,000 m^3 (740,000 cu. ft.) of lumber. The Australian government operates a sawmill to train local sawyers and some skilled laborers. As production expands, Australia hopes to meet not only the present annual requirements of the territories, but to obtain considerable quantities of hardwoods for Commonwealth use. Although prewar annual consumption of timber in the territories was not great, it is estimated that rehabilitation requirements will need almost 23,600 m^3 (830,000 cu. ft.) a year for the next five or six years. Minor forest products include sago from the *Metroxylon* palm, nipa palm leaves for thatching, mangrove bark for tannin, dammar gum, canes, and bamboos.

Among the problems facing any forestry program in the territories, one of the most urgent is the control of shifting cultivation. Territorial forest reservations will have to be made to meet local demands and expanded export industries. A comprehensive inventory should be made, taking advantage of the excellent aerial photographs that are available. It will be necessary to secure trained foresters, and such training is being provided at the Australian Forestry School at Canberra. Plans are under way for a research program in silviculture through the Commonwealth Forestry and Timber Bureau, and in products through the C.S.I.R. at Melbourne.

New Zealand

New Zealand has a land area of over 26 million hectares (64 million acres) which is 26 percent forested. Of this, almost 2 million hectares (5 million acres) are classified as productive forest. The population is less than 2 million, so the per caput productive forest area is 1.1 hectares (2.7 acres). At the present time 60 percent of the productive forest area is considered inaccessible. The accessible forest consists of 85 percent coniferous species and 15 percent hardwoods. Two-thirds of the forest area is publicly owned, principally in the form of state forests with a small area in communal forests. Exotic conifer plantations constitute almost 50 percent of the total accessible forest land. Estimated volume of the accessible productive forest is 31 million m^3 (1,100 million cu. ft.) of conifers and 19 million m^3 (670 million cu. ft.) of hardwoods with an average volume per hectare of 47 m^3 (670 cu. ft. per acre) for conifers and 316 m^3 per hectare (4,520 cu. ft. per acre) for hardwoods. Annual growth has been roughly estimated at over 1.5 million m^3 (53 million cu. ft.), or an average of 2.4 m^3 per hectare (34 cu. ft. per acre). Average annual fellings are in excess of net annual growth.

Indigenous forests are classified as rain forest and beech forest. Rain forest consists of *kauri, Agathis australis; rimu, Dacrydium cupressinum;* white pine, *Podocarpus dacrydioides;* and *totara, Podocarpus totara.* Beech forest consists of a number of *Nothofagus* species. The exotic plantations consist principally of *Pinus radiata,* with a number of other conifer species from the United States. Production, which in 1947 was almost 3 million m^3 (106 million cu. ft.), was made up almost 50 percent of *rimu* and about 30 percent of *Pinus radiata.* The remainder of the production consisted of *Podocarpus* sp., *kauri,* and beech.

There are 608 sawmills, most of them cutting heavily in the indigenous conifer forests. In the past, much of this cutting implied clearing land for agriculture, and progress was slow in obtaining public recognition of the need for regeneration of these forests. Because of the phenomenal growth rate of *Pinus radiata,* considerable money was invested by private companies in plantations of this species in the 1920's and 1930's. The government itself utilized unemployed labor during the thirties to establish large acreages of such plantations in the state forests. Most of the original investors, however, failed to realize the anticipated quick profits. At the present time these government and private plantations are supplying several large government sawmills, a large number of private mills, pulp, paper, and fiberboard mills.

There is a danger of serious overcutting in the indigenous forest on the one hand, and a concerted effort to utilize the rapid growth of the exotic plantations on the other. Industry has been faced with a serious shortage of manpower, but because of ac-

tive government efforts to supply high-standard housing and improved living conditions, the wood-using industry is somewhat better off in this regard than other industries. New Zealand is in an excellent position to maintain sizable exports in exotic pine lumber but must depend on imports for its hardwood supplies. Thus Australia and New Zealand are complementary to each other to a large degree. The expansion of government operation of sawmills and pulp and paper mills will, of course, affect this situation considerably. One difficulty is the shortage of shipping and loading facilities.

The State Forest Service has a small headquarters staff in Wellington and seven conservancy regions, each under a forest conservator. The remainder of the staff consists of 8 foresters, 5 assistant foresters, and over 125 forest rangers. The Director of Forestry is seeking to recruit more trained forestry personnel and hopes to reinstitute forestry training, which was suspended in 1934. The plan is to establish a training center at Rotorua, which is also the site of the newly established Forest Experiment Station. The faculty of the training center would include some of the research personnel. Past research work has included important contributions on such subjects as timber testing of most of the commercial species, air seasoning and kiln drying, and the protection of lumber against insect attack. The work on forest management, silviculture, entomology, and pathology has been concentrated in the past on exotic pine plantations and is now being expanded to cover the indigenous coniferous forests. An important research activity is the National Forest Survey, which is making excellent use of aerial photographs in combination with ground cruising methods to determine not only the volume, growth rate, and degree of natural regeneration, but is also obtaining ecological information as a basis for the development of effective forest management methods. Considerable effort has gone into fire protection of exotic pine plantations. Modern fire-prevention and suppression techniques have been adopted.

In view of the present efforts of the Government to increase population through immigration, the old question of land use is being re-examined. The distribution of land for high-value sheep production and farming as compared with land to be devoted to forest production and for soil and water protection purposes are matters of grave concern. Unwise land use has caused extensive erosion, especially on overgrazed slopes which should have been left in timber.

The principal problems in New Zealand include the recruitment of trained forestry personnel, manpower shortage, expansion of forest research, rational planning of utilization to relate productive capacity of sawmills and paper mills to the growth rate of the indigenous conifer and beech forests, and especially of the exotic pine plantations. More adequate control of exploitation in indigenous forests, perhaps through a revised forest policy, is needed.

North Borneo

Before the war, North Borneo was a British protectorate governed by the Chartered Company of North Borneo. Since the war direct administration has been taken over by the British Colonial Office. It has an area of 7.5 million hectares (18.5 million acres), which is 82 percent forested land. Of this slightly over 1 million hectares (2.5 million acres) are classified as productive forest. The population before the war was 400,000, so the productive forest area represented 2.6 hectares (6.4 acres) per caput.

Of the total productive forest area one-fourth is considered accessible, consisting of mixed dipterocarps and mangroves. The forest types are similar to those in much of Indonesia and Malaya. Except for certain small alienations of private land, practically all of the productive forest is state-owned. Rough estimates place the total volume of commercially exploitable species at 11 million m^3 (390 million cu. ft.) with an average stand per hectare of 42 m^3 (600 cu. ft./acre). Average annual fellings before the war were over 350,000 m^3 (12 million cu. ft.). This is more than 50 percent in excess of the estimated net annual growth. Before the war there were 5 sawmills, 1 tannin extract plant, 170 charcoal kilns, and 1 wood preservation plant, which, with the logging operations, employed annually almost 7,000 people. As a result of the Japanese occupation, all industrial installations were destroyed with the exception of the tannin extractory. Since the war, a small number of sawmills have begun operations to meet the needs of the local population for rebuilding.

Before the war, exports of hardwood logs and lumber reached volumes of over 250,000 m^3 (8.8 million cu. ft.) per year. These exports were sent principally to Hongkong, Japan, the British Isles, and China, with small amounts to Australia and Africa. In addition to the timber for export, North Borneo is a potential fuelwood exporter, especially to Hongkong. It used to ship important quantities of cutch and mangrove bark, dammar gum, and jelutong.

The trained forestry staff returned after the war to find all its records completely destroyed. Considerable effort is being required to reinstitute forestry administrative work and to control shifting agriculture. The replacement of sleepers, bridge timbers, and housing for forest labor is absorbing most of the present productive capacity.

Republic of the Philippines

The numerous islands forming the Philippines group have almost 17.5 million hectares of forest land, some 59 percent of the total land area, and support a population of over 19 million people. Between 95 and 100 percent of the forest land is owned by the Government. The islands of Luzon, Mindanao, Samar, Negros, and Palawan are the most heavily forested. Of the 3,000 tree species known to occur in the islands, less than 60 are now brought to market. Seventy-five percent of the productive forest consists of dipterocarps, more commonly known as the *lauans*. It is estimated that the volume of commercial standing timber is well over 1,000 million m^3. In addition to the dipterocarp type, there is the *molave* forest which occurs mostly in the dryer limestone areas; the pine type, comprising *Pinus insularis* and *P. merkusii*, which occurs in the high mountains of northern Luzon and Mindoro; the mangrove type along the tidal flats; and the midmountain and mossy type, which occurs at the higher elevations and is principally protection forest.

The commercially important timbers can be grouped into (1) *lauans*, *Pentacme contorta*, *Shorea negrosen-*

sis; (2) apitongs, *Dipterocarpus grandiflorus;* (3) *guijos, Shorea guijo,* (4) *yakals, Hopea* sp.; (5) *other* dipterocarps; and (6) legumes. The wood of most of these species has been tested; the mechanical properties and the most suitable uses are known. Minor forest products include the firewood and charcoal, palm products, cutch and tan bark, fibers, resins, gums, oils, rubber and gutta percha, beeswax, and medicinal plants. The Bureau of Forestry is responsible for issuing short-term (one year) and long-term (five to ten years) licenses for the extraction of timber and minor forest products. There is a stumpage charge for all timber cut, varying with the value of the species. In addition, there is a reforestation tax which goes into a fund for forest planting. There is also provision for free use by individuals, by religious institutions, and for public works.

In 1941 the 163 sawmills, having a daily capacity of over 3,500 m^3, employed about 70,000 people. Annual production was well over 2.4 million m^3. During the war, production of logs and lumber was practically at a standstill. After the liberation in 1945 only 38 sawmills, with a total daily capacity of less than 700 m^3 were in operable condition. At present there are 342 sawmills with an aggregate daily capacity of about 5,000 m^3. Of these, 207 are connected with logging operations and the remaining 135 depend on purchased logs. Production in 1948 is estimated to be about 3.2 million m^3 (log scale), or a total lumber output of almost 593,000 m^3. There are about 50,000 people employed in the lumber industry. In order to promote reconstruction there was a restriction on export of lumber, but as rebuilding progressed rapidly, the quota for export was increased to 50 percent of production, and there was a total exemption of peeler logs and flitches. In 1948 over 40,000 m^3 of logs and 6 million m^3 of sawn lumber and flitches were exported, a major share going to the United States. All export lumber and timber must pass government inspection according to Philippine grading rules or those of the U. S. National Hardwood Lumber Association.

The lumber industry has set an annual production goal of 4.7 million m^3. To achieve this, many of the present mills, which are of the U. S. Army type, and much of the logging equipment will have to be replaced. It is also felt that greater investment will have to be made in additional sawmills, finishing mills, veneer mills, dry kilns, wood preservation plants, and box and barrel manufacturing plants.

The Bureau of Forestry consists of a director with an advisory staff, an inspection service, a field service of 44 provincial forest districts, and 144 forest stations. It has the following divisions: administrative, investigation, management, engineering, reclamation and reforestation, concessions, and sawmills and utilization. The Bureau is responsible for classification of land which is to be converted from forest to agricultural use. It also administers national parks, forest reservations, and communal forests and pastures. One of its chief activities is the reforestation of cut-over land and especially of the 5 million or more hectares of wasteland largely covered by *cogon* grass, *Imperata exaltada,* which moved in when the forest was destroyed by shifting cultivation. The Forestry School of the University of the Philippines was established in 1910 and up to 1948 had graduated 638 men in the ranger course and 182 in the professional forestry course. Eighty percent of the present personnel of the Bureau of Forestry are graduates of the school at Los Baños. A large share of the research work is concentrated there in connection with the school, and many research persons also teach.

The major problems include the following: (1) rehabilitation of laboratories, records, library, equipment, and museum collections; (2) lack of trained men to fill the ranks of government services; (3) more rapid progress in classification of land which is being requested for farms by ex-service men; (4) more adequate control of forest destruction by roving agriculture; (5) financial backing and technical guidance for rapid rehabilitation of the lumber industry; and (6) expansion of research in use of forest products.

Sarawak

Situated on the northwest side of the Island of Borneo, this British colony is 89 percent forested, with a forest area of 10.5 million hectares (26 million acres). Of this, not quite 4 million hectares (10 million acres) is classified as productive forest, largely dipterocarps. There is also a small but important area of mangrove forest. The population is half a million, so there is almost 8 hectares (20 acres) of productive forest per caput.

Little damage was done to records, experimental installations, or to standing timber during the Japanese invasion and subsequent Allied operations. Demarcated forests cover not quite 8 percent of the land area of the colony. Forest working plans have not been considered necessary, inasmuch as silvicultural operations have been aimed principally at the production of jelutong for chewing gum, and the planting of *Shorea* and *Casuarina.* In 1946 production consisted of 14 million m^3 (490 million cu. ft.) of sawlogs, 56,000 m^3 (2 million cu. ft.) of fuelwood, and 2,500 tons of charcoal. Twelve sawmills were in operation. Cutch, dammar gum, and rattans are also important.

Additional working capital and equipment are needed to fulfill the promise of a growing lumber industry. Efforts are being made to revive the export trade with Borneo, Singapore, the United Kingdom, and China, and to begin trading with Australia and South Africa.

Siam

Siam has a land area of over 51 million hectares, which is 63 percent forested, all classified as productive. The population is over 18 million, so there is almost 1.8 hectare of productive forest per caput. The forests are in the hilly regions surrounding the central plain and along the narrow strip of the Peninsula. The eight main drainage basins are important factors in the transportation of teak. Two of these basins empty into the Salween River, which takes Siamese teak logs to Moulmein in Burma, and two other basins empty into the Mekong, which takes them through French Indo-China. The other four basins join together to form the Menam, which brings teak logs past Bangkok. This division of teak transportation complicates the administration of teak concessions because it involves dealings with Burma and Indo-China.

The forest types include evergreen forests in the

moist regions, made up principally of dipterocarps and *Hopea*, with occasional teak trees, and the hill conifers, *Pinus khasya* and *P. merkusii*. These forests, which are largely confined to the Southeast and the Peninsula, yield a number of valuable timbers, bamboos, and canes. The principal type in Siam is the mixed deciduous forest, containing important quantities of teak along with numerous dipterocarp species, *Pterocarpus* sp., *Xylia* sp., *Lagerstroemia* sp. and *Terminalia* sp. Along with these grow numerous useful bamboos. Mangrove grows along the coast and in swampy areas. On the lateritic soils there are mixed hardwoods, which are important as a source of fuel. All teak is the property of the Government, which grants concessions to private operators. Logging is done principally by hand methods, with primary transportation to streams and tramways by elephant. Recently, in the drier sections, tractors and trucks have been brought in to replace the elephant. Before the war, European firms held 85 percent of the logging concessions, but now the whole question of timber leases is being re-examined with some possibility of increase in government exploitation. Control of exploitation for all products has been greatly disturbed during and since the war. The system of leases and permits requires, for adequate administration, a larger staff than is now available.

The Forest Department of Siam was created in 1896, very much along the lines laid down by Brandis in Burma. Support for the organization has fluctuated through the years. Management methods are similar to those used in Burma, namely, the group and tree selection system with improvement cuttings and the natural and artificial regeneration of teak. In addition to the valuable teak timber there is considerable production of bamboo, lac, charcoal, fuelwood, special furniture woods, gutta-percha, gum benzoin, wood-oil from the dipterocarps, gamboge, and nipa palm leaves.

Foresters are trained in the Forestry School at Phrae. Professional training courses are being considered for the College of Agriculture near Bangkok. The recent FAO Mission to Siam recommended a reorganization and strengthening of the forest department under the Minister of Agriculture. It emphasized especially increasing the field staff in the divisions and provinces. The Mission also recommended an aerial survey of the country. There is need for systematic reservation of forests for watershed protection and for commercial production. Watershed protection is especially important to assure adequate water supplies for rice cultivation in the plains. The Mission estimated that if 20 percent of the forest land were reserved for commercial production it could yield annually 25 million m^3 of timber and firewood, thus meeting Siam's requirements. As to the needs for firewood, poles, and stakes in the vicinity of fishing villages, tobacco-curing sheds and railway stations, the Mission recommended the establishment of fuelwood plantations, principally of eucalypts and *Casuarina*. It recommended further that farmers in the Central Plain, where trees are scarce, be encouraged to grow trees on small bits of land otherwise wasted. Species are to be selected to produce firewood, poles, tanbark, lac, and shade and fodder for cattle.

The Mission also felt that artificial regeneration should be undertaken on a large scale, employing the *taungya* system, as developed in Burma and Indonesia for teak. Closer administration of logging concessions should also be aimed at, with natural regeneration where feasible. An important recommendation of this Mission was for the strengthening of the Research Division of the Forest Department, including the setting up of an equipped laboratory to study wood chemistry and wood technology, and to emphasize silvicultural research in the forests.

Solomon Islands

These Islands, under British protectorate before the war, have a land area of almost 3 million hectares (7 million acres), 94 percent of which is forested. Of this, less than 21,000 hectares (52,000 acres) are considered to be accessible productive forest and over 2.5 million hectares (6 million acres) are classified as nonproductive forest, including a small amount of "bush fallow" rotation under shifting agriculture. The population was estimated in 1945 at somewhat over 94,000. Very few Europeans have returned since the war. Less than 6 percent of the land area has been alienated through Crown or other leases, occupational leases or freehold, but there are no forest reserves.

The forests consist of the littoral and inland types. The littoral forests are composed of the beach forest of *Calophyllum*, *Barringtonia*, *Terminalia*, *Casuarina*, *Intsia* and *Hibiscus*, and mangrove forests. The inland forests are made up principally of *Pometia*, *Vitex*, *Calophyllum*, *Terminalia*, and in small areas *Agathis* in the lowlands and foothills. There are also fresh-water swamps with *Calophyllum* and *Terminalia*. Clearing for shifting cultivation has produced mixtures of savannah and low-value tree species, including bamboo. The timbers of the islands have been studied and found to be useful for furniture, posts, and general construction, and such special uses as carving, turnery, oars, tool handles, and veneers. Minor forest products include mangrove tanbark, cordage for nets from rattans, thatching, dyes, and medicines.

The islands produced timber for the armed forces during the war, mostly through the use of U. S. Army sawmills and logging equipment. Some estimates place this at over 28,000 m^3 (1 million cu. ft.). Fuelwood consumption has been estimated at about 0.08 m^3 (2.8 cu. ft. per person per year, which would mean a total production of over 7,500 m^3 (260,000 cu. ft.). Sample enumerations on most of these islands give a rough estimate of almost 8 million m^3 (280 million cu. ft.) of standing timber, with the heaviest concentration in the New Georgia group, Santa Isabel Island, Guadalcanal, and Choiseul.

Forest industries include a logging and milling operation on Malaita and another on Vanikoro Island which produces *kauri*, *Agathis* sp., timber similar to that produced in New Zealand. Canoe and boat building are also important activities.

Problems include the organization of a new forest department, passage of forest legislation, establishment of forest reserves, silvicultural operations in the *kauri* forest of Vanikoro, encouragement of exploitation under proper control, better utilization of local timber, and the initiation of research into growth rates and methods of regeneration.

News of the World

The items appearing here are condensed selections of news thought to be of interes to readers of UNASYLVA. *They are grouped alphabetically by countries under headings currently used by the Division of Forestry and Forest Products for reference purposes. The Editor will be glad to receive direct from readers authenticated items of interest and news value for this part of the review.*

General

CZECHOSLOVAKIA

Forest research in Slovakia is being reorganized. The Slovakian forest research institutes, which go back to 1906, are entirely autonomous, although coordinated in a general way with similar institutes in Bohemia and Moravia. Such autonomy is dictated by the need for decentralization and because forest conditions in Slovakia are entirely different from those in the western part of Czechoslovakia. A Central Administration of State Forest Research Institutes was created in 1947 with headquarters in Banska Stiavnika. This new office is charged with supervision and direction of the work of the existing institutions dealing with silviculture, forest biology, forest pedology, forest entomology and pathology, dendrology, forest economics and taxation, lumbering and wood technology. The Central Administration is to organize an institute for forest protection and other specialized institutions. The creation of new institutions, however, will be delayed for a time by lack of qualified personnel and suitable buildings. The Forest Research Administration now operates two forest experiment stations that are to be replaced by a network of biological stations representing as many different types of forest as are to be found in the country. The Central Administration of State Forests in Bratislava gave the Research Organization full control of a forest tract of 1,300 hectares and of a sawmill; revenue from this forest to be used for the development of research. The research staff is also being given facilities for field work and experimentation in state forests generally. The several institutions are now housed in one building in Kosice, which is also the seat of the Slovak University of Agriculture and Forestry.

FRANCE

The International Poplar Commission, which unites national Committees established in many European countries, has an active French National Committee. This group, with its chairman, P. Garnier, is conducting a campaign in favor of wider use and better utilization of poplars. It actively participated in the preparation of two regional conferences organized by the Private Forests Division of the Department of Waters and Forests of France, at Toulouse on 7 and 8 May 1948 and at Niort and Rochefort from 12 to 14 May. Many forest owners attended these conferences, which included lectures, discussion meetings, educational tours, and visits to factories.

SPAIN

In October 1948 ceremonies were held in Madrid to commemorate the centenary of the Spanish Forestry School and the creation in that country of a corps of Forest Engineers.

UNITED STATES OF AMERICA

To celebrate the first 50 years of its existence, the International Paper Company has produced a special publication. In surveying the accomplishments of the company, certain ideas are stressed which are very interesting as examples of the lines of thought the industry is following, especially with reference to integrated utilization. Today International companies "convert" one-sixth of their paper and board output into such products as shipping containers, grocery bags, multi-wall sacks, paper milk containers. Chemicals are produced as pulp-mill by-products. Canadian affiliates manufacture building boards and plywood. Integrated operations make for fuller use of existing resources. Underlying all pulp-making is forestry. In Canada and the northern United States, forests under the company's control grow as much wood as is consumed. Its objective everywhere is to achieve a balance between growth and consumption, and at the same time make maximum efficient use of the products of every forest acre.

Fundamental Science

MOROCCO

A forester in the Spanish zone of the Protectorate of Morocco has recently drawn attention to a forest range in the Tazaot Mountains, about 25 kilometers northeast of Chauen, where, at an altitude of between 1,400 and 1,700 meters, there is a stand of about 1,500 hectares of a type of Mediterranean fir closely allied to the Pinsapo firs, *Abies numidica* and *A. marocana*. It is proposed to name it *A. tazaotana*. Comparing the tree with *A. numidica* and particularly *A. marocana*, it appears that it is a special race of Pinsapo. It is probable that, following the breaking of the link between the continents of Africa and Europe and the forming of the Straits of Gibraltar, these species evolved various types of trees, by progressive or regressive evolution. The most regressive type would be *A. marocana*, the average height of which is from 12 to 15 meters in open stands, often composed entirely of malformed trees. *A. tazaotana*, which averages from 30 to 45 meters in height and with a more elongated cone, would represent the progressive type. The most striking general difference between this tree and the Pinsapo firs is that its crown is not pointed but flat, recalling closely *Cedrus atlantica*.

The local climate ranges from temperate to cold. The soil is liassic limestone with a thick layer of humus. Counts made in this forest have shown that the volume per hectare for this species amounts to between 600 and 800 m^3. The composition of the stand includes up to five trees per hectare with a diameter of between 1 and 1.50 meters at breast-height and heights of from 35 to 45 meters. There is an almost complete absence of trees of diameter between 0.10 and 0.40 meters because the local population will not fell trees of more than 0.45 meters' diameter as they do not have the necessary tools. Mixed with these firs are some maples, *Acer granatense*, and several oak species; *Quercus mirbeckii*, *Q. pyrenaica*, and *Q. toza*. The most common shrub in the understory is a variety of *Ilex aquifolium*.

Silviculture and Management

FRANCE

After the first World War, France had to convert large areas of what had been mostly agricultural land, where the Battle of Verdun was fought, into forests. An area of 13,500 hectares, on which the work was extremely difficult because of the upheaval of terrain, was planted with mixed stands of Scots pine, *Pinus sylvestris*, and black pine, *P. laricio*, or equal mixtures of spruce and hardwoods (birch, alder, maple, acacia, ash, etc.), or of black pine and broadleaf species. Some land was also restocked with sowings of pine and fir. Finally, poplars were planted in the valley of the Meuse in meadows subject to periodic flooding but which have been well drained.

After 20 years the results are beginning to show. Among the softwoods, only the black pine, which is well adapted to the heavy chalk soil and the local climate, has produced uniformly good results. Spruce and Scots pine have not proved very suitable. Poplars showed excellent results and some marketable products have already been obtained from these stands. Results vary greatly for the other broadleaved species according to the location. The general appearance of the reforested areas is still artificial and patchy. Years will elapse before the soils will have recovered sufficiently to bear real forests.

ICELAND

Forty thousand two-year-old pine seedlings and 25,000 spruce seedlings will be shipped by airplane from Norway to Iceland. The seedlings were carefully chosen from an area in Norway where the climate is very much like that of Iceland.

INDONESIA

One of the important problems in forest management in Java, which is closely tied to the exploitation of forests of teak, *Tectona grandis*, is the afforestation and cultivation of poor soils not suitable for the cultivation of teak. Solution of this problem is more difficult in the arid regions of central and eastern Java, or in the arid regions, for instance, of the Lesser Sunda Isles. Though a number of species have been found locally suitable for the afforestation of poor soils, in practice only *Swietenia macrophylla* and *Dalbergia sissoo* are of economic value. The results of afforestation with eucalypts in other parts of the world justify investigation into their possibiilties for Java, especially since eucalypts produce excellent timber.

MEXICO

A change in import and export duties reflects a significant trend towards conservation of Mexican forests. Whereas import duties changed only slightly, there was a marked increase in those of exports, so that export of Mexico's forest products will now be much more costly. This step followed long endeavors to interest the public in forest conservation, which have not had the desired effect.

Modern forest nurseries have been established and an extensive campaign launched in the press and the schools to protect the forests. A number of timbered areas have been set aside as national forest preserves and parks, and in certain regions cutting is absolutely forbidden. Large-scale reforestation of denuded areas has not yet been started, although a small amount of planting has begun. Lack of modern tractor-driven automatic tree planting machines is possibly the reason why the reforestation program lags. Until recent years little interest had developed in the conservation and perpetuation of the country's forest resources. The Forest Service, as now organized, generally follows methods similar to those in use in the United States, and appears to be increasingly in a position to control exploitation.

Rational exploitation of Mexico's forests will have to wait for expert knowledge of what these forests contain, the quantities available, and what they are best suited for. The cutting of logs for export will have to be discontinued, and instead they must be processed into manufactured or semifinished products in Mexico before being exported. Given the necessary technical direction and adequate government encouragement, the industry could, within a few years, be developed to a point where it could supply practically all national requirements and still export. It seems paradoxical that this country should import wood and wood products, while a large part of its territory is covered with some of the finest forests in the Americas.

UNITED KINGDOM

On waste land in the Black Isle, where even heather will not grow, Forestry Commission planters, by deep plowing, are planting forests that will one day make the area one of the most productive in Scotland. With 35 percent of the Black Isle in woodland—20 percent of it under the Forestry Commission—forestry men working a new type of plow, designed to tear up even the roughest ground, aim to plant nearly 1,200 hectares (3,000 acres) more. To combat fire, the Commission had trained and equipped a special body of firefighters. These men, operating Army Bren gun carriers fitted with hoses and water tanks, can speed over the roughest ground and act as fire-fighting shock troops until the main appliances arrive.

UNITED STATES OF AMERICA

The annual report of the Crown-Zellerbach Corporation pointed out the successful use of a helicopter in seeding isolated forest areas with new trees. The company said it conducted the largest forest restocking program in its history in the fiscal year ending 30 April 1948. Nearly 1 million seedling trees of pulp species were hand planted in 648 hectares (1,600 acres) in the Northwest area. Another 1,400 hectares (3,500 acres) were seeded by hand or from the air by helicopter. Satisfactory results are now becoming apparent from the airplane seeding and hand broadcasting done in previous years.

Forest Protection

CYPRUS

The problem of grazing, especially of goats, is the most serious factor involved in forest conservation in the Mediterranean region. Two recent reports published by the Conservator of Forests of Cyprus, one for the years 1939-1945 (which was submitted to the last British Empire Forestry Conference) and the second for 1946, give interesting data on the progress recently achieved in the island.

This progress can be attributed in a measure to wartime circumstances. The normal forest increment on the island would be 1.4 m^3; and it is estimated that intensive grazing reduces this increment to 0.4 m^3. In addition, the soil losses are even more serious. Soil recovery is practically impossible. Finally, although the presence of animals, especially goats, in the forests causes considerable harm, the shepherds themselves are responsible for the greatest damage—they cause most of the forest fires.

Almost the entire forest area where free grazing was allowed belongs to the State. The policy adopted in all sections where pasture rights belonged to individuals or isolated, clearly determined communities, has been to bargain with them and offer them substantial compensation in exchange for the relinquishment of their rights. This action was taken first in dealing with monasteries, which recognized that the pasturing of flocks in forests was an abuse of the land. It was later extended to dealings with private individuals grazing flocks in forests with no legal authority, and who were at first requested to obtain regular licenses and then gradually persuaded to relinquish their rights. A forest law called the "Goat Law" granted villages certain privileges on condition that they would agree to restrict the pasturing of goats to specified areas outside forest lands. Finally, strict supervision was exercised to ensure the proper enforcement of the agreements reached. Thanks to this policy, most of the forests on the mountain range of the southwestern portion of the island are now protected from grazing.

The position was more difficult in the limestone northern coast range where the rights of pasturing of flocks were not in the hands of individuals, as was generally the case on the southwestern mountain range. Pressure is strong from villages isolated in the forests, which have very little agricultural lands available and where shepherds had always earned their living by raising sheep and goats. Moreover, supervision is more difficult there. Compensation to the shepherds for the relinquishment of their rights in the south was generally provided in the form of stable employment elsewhere. Thanks to wartime circumstances and the large financial credits the Forest Service obtained from the Colonial Development Fund, such employment was expanded.

In the northern portion of the island, it would of course be possible to employ large numbers of men in reforestation and forest planting work. There are sufficient funds available for this purpose, but the work would provide temporary employment only. Therefore, consideration is being given to a policy of moving the villages in this zone and re-establishing them on more fertile and accessible lands. An experiment of this kind, which is being tried out with a village at the request of the inhabitants themselves, seems to give promise of excellent results.

CZECHOSLOVAKIA

Bark beetle infestation, drought, and fires caused a great deal of damage to the forests of Bohemia, Moravia, and Silesia during 1947. Insect infestations had already been reported in some places during the years 1943-1945, but they assumed epidemic proportions during the exceptionally dry year of 1947. Infestation also became widespread in neighboring countries like Austria, Germany, Poland, and even as far as Sweden and Yugoslavia. Shortage of labor, lack of transportation, neglect of barking felled trees and windfalls during the war years, all created favorable conditions for the mass outbreak of bark beetles. This mass infestation continues in some places, while it is subsiding or is entirely checked in others.

The catastrophic drought of 1947 also destroyed from 50 to 60 percent of the plantings of that year and killed many trees at the pole stage, especially the shallow-rooted spruce. Because of exceptional dryness, many forest fires raged, especially along railroads, and burned hundreds of hectares of forest.

FRANCE

Attempts have been made to combat the invasion of *Bostrychidae*, which is causing serious damage to European forests, by using insecticides such as DDT, Gesarol, and hexachlorohexane. Unfortunately, the same excellent results as those previously obtained against leaf parasites were not achieved. The tree trunks could not be reached by spraying from the air. There is no apparatus that can spray insecticide effectively to a height of 20-30 meters from the ground; if there were, it would be extremely costly. The only really effective means

of combating *Bostrychidae* are still preventive silvicultural methods of maintaining stands of spruce and fir in perfect condition and planting artificial stands only in a suitable environment.

Conversion

Canada

A new machine at the plant of the Powell River Company, Powell River, British Columbia, which cost approximately three million dollars, will have a production capacity of 365 meters (1,200 feet) of newsprint per minute. Its seven-man crew has been operating it on an experimental basis for several months. The machine, which is probably the fastest in the world, is capable of turning out 610 meters (2,000 feet) of newsprint per minute. Its production of about 250 short tons per day on a round-the-clock basis will increase the Powell River production to 233,000 metric tons (257,000 short tons) per year. The new machine's production will almost equal the combined output of the four original machines installed in the plant between 1912 and 1914; they are still operating. Each of these machines produces approximately 204 meters (670 feet) of paper per minute. One of the features which has speeded up production on the new machine is a revolutionary new headbox, which cost $75,000 to design and install.

Finland

An account of investigations carried out at the A. B. Centrallaboratorium O. Y. in Finland shows that mechanical pulp dried to 75 percent dryness does not get mouldy. At 70 percent dryness the development of mould is inconsiderable. At a lower dryness percentage than 70, a rich growth of fungi can be found, apparently due to the fact that the air between the sheets in a bale in this case has a relative humidity of 100 percent. If drying proceeds under favorable conditions (30 percent relative humidity and 85°C.), its influence on strength is small, corresponding to a reduction by 3 percent at the most. The folding endurance, however, showed a greater sensitiveness. The breaking up of the pulp showed increasing difficulties when the pulp was dried to more than 70 percent b.d. During 6 months' storage, all the samples, the air dry pulp included, had changed to such a degree that the time for breaking up the pulp was much longer than before storage. It also appeared that the moist pulp, if penetrated during the storage by hyphae, can be more difficult to defibrate than the undamaged dry or half-dry pulp.

Poland

The factory at Bydgoszcz, which produces tools and machinery for the wood manufacturing industry, now employs approximately 400 workers and produces 38 different kinds of machinery. It resumed operations in March 1945.

United States of America

The first rayon pulp mill designed to employ a new process for producing dissolving woodpulp used in the manufacture of rayon and other synthetic products is to be built in the South by International Paper Company. Hardwoods instead of softwoods will be used for the first time in the manufacture of rayon pulps, with a new process based on the sulphate (kraft) process instead of the traditional sulphite. The mill is to have a capacity of 300 tons a day or an annual capacity of 100,000 tons. This output would increase the present estimated North American production of rayon pulp by 16 percent. This development means that dissolving woodpulp output will be sufficient for the first time since the end of the war to meet the demand for new rayon yarn capacity, existing and authorized. The new project involves radical changes in the sulphate process and novel methods of purification and bleaching. The result is a dissolving pulp which not only produces yarn and other end products of superior strength but which can be processed more rapidly by the converters, with lower operating costs and considerable savings in their capital investments.

U.S.S.R.

As a part of the plan to place the lumber industry on a highly mechanized footing, more than 10,000 electric saws were supplied to the lumber industry in 1947.

Utilization

France

The French Commission for Standardization of Cellulose and Paper met last summer in Paris. Before the meeting an enquiry was made among the interested industries to find out if they would consider setting up a commission, the purpose of which would be mainly: (1) to study production, transformation, and utilization of pulp insofar as it has not been studied by existing special commissions, (2) to co-ordinate the work of these special commissions in order to arrive at a greater unity of views. In the course of the meeting, the Commission discussed pulp as a raw material, derivatives of pulp obtained by chemical treatment, and paper, textiles, celluloid, powder, varnishes, etc. Considering that it is extremely important to standardize the testing methods in the pulp and paper industry, the Commission has entrusted the National Bureau of Standards for Paper with drafting a first project. The derivatives of pulp will be studied thoroughly by the Commission. With regard to finished products, their standardization will be assured by the Bureau of Standards. The idea of referring the study of such products to commissions is intended to ensure the best technical results by dividing the work between the most expert technicians in the field. However, no matter which commission carries out the work, the Commission for Cellulose will always centralize and co-ordinate.

New Methods

Canada

A new use for the enormous tonnage of waste—sawdust, wood shavings, end trimings, edgings, slabs, and bark—is seen with the announcement that contracts have been signed for construction of a "Plaswood" plant at South Nelson, New Brunswick; cost of erection is to be $200,000. The plant is expected to be in operation soon, to produce 59 m³ (25,000 bd. ft.) a day, and employ about 25 men. "Plaswood," a copyrighted trade name, is the result of continuous research and development during the last ten years. The process is said to convert all kinds of wood waste into a wide range of wood products through the use of special drying equipment and the admixture of a urea synthetic resin. Flat or curved boards (of the required thickness and density) are produced by the use of multiple-opening hydraulic presses. Intricate wood-work is also automatically produced through extrusion.

Canada's first cellulose sponge plant commenced operation at Vancouver early last August, when Canada Pulp Products Limited opened its $100,000 factory on Granville Island. The new plant will provide full-time employment for 30 workers and will utilize as its prime raw material high-grade white pulp supplied by British Columbia's forest industries. Commercial and domestic types of artificial sponges will be produced. A laboratory in the plant will conduct research on new cellulose products.

India

Studies on adhesives are contained in leaflets Nos. 97 and 100, issued by the Forest Research Institute, Dehra Dun. Experiments on tar acid formaldehyde resins were mainly concerned with phenol-formaldehyde resins. At a certain stage of the war the position of phenol was very critical. But a limited quantity of "pale cresylic acid" was available. The experiments carried out on the utitlization of this cresylic acid are described in pamphlet No. 97. Other experiments show that it is possible to produce adhesives from castor cake proteins suitable for the manufacture of commercial plywood, even though the results are not as good as those obtained with groundnut proteins.

Sweden

Paper parachutes produced by the Nissafors Company and successfully tested and used in Sweden are said to have aroused great interest abroad and may become an important Swedish export commodity. It is reported that 3,000 of these parachutes have been ordered for the French Army in Indo-China. The United States and other countries are also said to be showing an interest in the new product.

United States of America

A new method of prefabricated house construction using an inexpensive but durable combination of wood veneer and kraft paper has been successfully tested. Known as "K-Veneer," the new material is made of a single 0.48 centimeter (3/16-in) wood veneer, slit by a unique process, and bonded to 0.04-0.08 centimeter (.016- to .030-in.) kraft paper. Species and grades of wood formerly considered unsuitable for such purposes can be used, including hemlock and white fir. The new material is

said to be stiffer, stronger, and more puncture-resistant than insulation or gypsum-board, and stiffer and stronger than 0.64 centimeter (¼-in.) plywood as normally applied. For test purposes K-Veneer was made into wall and roof panels in full-sized housing sections, and the panels were subjected to condensation tests at the Pennsylvania State College that showed them sound under extreme contrasts between inside and outside temperatures. Mechanical tests at the U. S. Forest Products Laboratory were considered to have demonstrated satisfactory stiffness for roofing, as well as showing suitable strength for racking of wall panels, and for impact, column compression, and concentrated load requirements of partition panels. K-Veneer can be manufactured in a continuous machine that slits the veneer, bonds the paper and adds the mineral-surfaced felt. The process appears simpler than the manufacture of plywood.

Economics and Statistics

Argentina

A decree issued by President Peron will cut consumption of newsprint to one-half that of the past year. Its issue followed meetings between publishers and the president of the National Economic Council. It placed newsprint of all types, imported or domestic, under the law governing consumption and distribution of essential articles. It instructed the secretariat for Industry and Commerce to draw up the necessary measures for the Economic Council. It is said that only about $10 million could be allocated annually for future imports. This might reduce the supply to 50,000 tons a year from the normal 140,000. Domestic production of newsprint is still small.

Australia

The Prime Minister of Australia has assured publishers who use reel newsprint that consumption will not be reduced below the present 90,000 long tons for 1948. The sources of this 90,000 for 1948 are: Imports, 35,000 tons; Tasmania, 30,000 tons; from stocks, 25,000 tons.

Australia has concluded arrangements for the manufacture of newsprint in England that will be made from raw materials bought elsewhere by Australia It is understood that one arrangement is for the purchase of pulpwood from Newfoundland and another for the purchase of sulphite wood pulp from the west coast of North America. Another arrangement involves the purchase of 10,000 tons of mechanical pulp previously bought by the British Board of Trade from Scandinavia and 2,000 tons of sulphite pulp to be purchased elsewhere. Of the 12,000 tons of newsprint to be manufactured under this arrangement one-third will go to the British Newsprint Supply Co. in lieu of sterling payment.

Burma

Burma has undertaken a "two-year plan" of economic development to include a survey of Burma's natural resources, which is to evolve a final policy of industrialization. New industries to be developed include paper and chemicals. Action will be initiated to set up in the Akyab District a paper and bamboo pulp mill (combined with the manufacture of certain chemicals essential to the industry) based on the utilization of bamboos grown in the district, and in conjunction with the hydroelectric power available from the Saingdin Falls. A fresh survey of the bamboo resources, the best site for the factory, and of the hydroelectric possibilities of the Saingdin Falls, will be completed not later than the 1948-49 open season. Simultaneously with the completion of these surveys, the availability of plant and machinery will also be investigated and orders placed with a view to setting up the mill at the earliest possible date and getting into production by 1951.

Canada

Twenty-five Canadian newsprint manufacturers and 35 newspaper publishers from the United States met in a two-day session at the end of September 1948. The publishers' estimates of newsprint consumption amounted to a total of 5,437,000 tons by 1960. R. Fowler, president of the Canadian Pulp and Paper Association, estimated that there would be an additional 100,000 tons of newsprint from Canada in 1949 and that the Canadian industries would produce some further 60,000 tons per year for the next 10 years. He also thought that the publishers' estimates were too low because they did not take into account the backlog of unfulfilled demand for 1947. Canadian newsprint production in 1947 was 4,447,000 short tons, and is to be 4,575,000 short tons in 1948. The U. S. is to get 84 percent of this production in 1948 (3,850,000 tons) and 86 percent in 1949.

The estimated 1948 shortage of supply in the United States is 455,000 tons; this shortage is to drop to 280,000 tons in 1949, with an unrestricted demand in the United States for that year of 5,705,000 tons. According to the mathematical rate of increased consumption for 1925-1950, the United States would need 6,201,000 tons by 1960. In the period between 1920 and 1935, the cost of a newsprint mill had usually been estimated to be $30,000-$35,000 per daily ton. Today mill construction would cost $75,000-$80,000 per daily ton, to which must be added woodland expenditures on a scale unknown twenty years ago. A single newsprint machine which could have been installed in 1930 for $2 million would today cost $4.5 million.

Finland

After lifting all controls from the forest products trade on 1 June 1947, it became apparent that the necessary supply of fuelwood would not be forthcoming. The government accordingly took preliminary steps towards reintroduction of controls. However, by May 1948, it was possible to withdraw these proposals because imports of coal were expected to increase by 50 percent during the year, and arrangements are being made to transport fuelwood from surplus to deficit areas.

India

Substantial resources of bamboo forests exist in the Kanara District of Bombay Province, according to a statement by the Director of Publicity of the Government of Bombay. The bamboo is regarded as suitable for the manufacture of pulp and paper. The potential yield of air-dry bamboo is 252,000 tons annually, of which three-fourths is considered usable. Estimates indicate that if these forests were fully exploited, enough bamboo would be available to produce about 65,000 tons of pulp or paper annually. Several sites for mills have been suggested. The principal bamboo species are *medar*, *Dendrocalamus strictus*, and *dowga*, *Bambusa arundancea*. Chemical tests for both species are being carried out at the Forest Research Institute at Dehra Dun.

New Caledonia

For some years Bryant and May Pty., Ltd., of Melbourne, has been obtaining considerable quantities of match splints from Canada, but the increasing hard currency shortage has compelled the company to search for new sources. The Melbourne company has the cutting rights to two areas on the island of New Caledonia, a French possession. The first contains about 104,000 m^3 (r) (23 million super feet) of assorted timbers, and the second more than 450,000 m^3 (r) (100 million super feet) of assorted timbers. The distance to Sydney is about 1,600 kilometers (1,000 miles).

New Zealand

The first direct consignment of timber for South Africa is reported. The shipment consisted of 9,400 m^3 (s) (4,000 super feet) of *Pinus insignis*.

Plans have been made to establish the first wood-pulp mill in New Zealand to begin production in 1950. The initial output of the mill, which is to be built at Maraetai, near Auckland, by a private company, is expected to be about 10,000 tons of pulp annually, probably unbleached sulphate. A government-owned pulp mill is expected to be erected at Murupara near Auckland by 1952. Pine forests in the area will furnish the raw material to be used.

Norway

Import restrictions in European and other overseas markets threaten to reduce Norwegian exports of wood pulp. If current negotiations with western Germany result in a sales contract, the situation might improve temporarily.

Rumania

A forest utilization plan has been set up in Rumania providing for a total annual cut of 14.15 million m^3 r, of which 3.15 million m^3 r will be of coniferous wood and 11.0 million m^3 r of broadleaved wood. Of this total 200,000 m^3 r of coniferous and 35,000 m^3 r of broadleaved woods would be available for export.

Switzerland

For the early part of 1948, the wood supply has tended to stabilize. Domestic production has remained greater than before the war, import possibilities have remained relatively favorable, stocks have reached a level compatible with market conditions, and the demand for principal categories can be easily met.

The present favorable situation must be attributed to the fact that for about a year and a half it has been possible to import large quantities of roundwood, as was the case before the war. Switzerland will remain dependent upon roundwood imports, principally of softwood and to a lesser degree of hardwood. This dependence is particularly true of high-quality wood, softwoods as well as hardwoods. Proof of this is the still acute shortage in high-grade softwoods.

Union of South Africa

The launching of Masonite products in South Africa is the culmination of over six years of preparatory work and intensive investigation. The industry is being established by Masonite (Africa) Limited under the technical guidance and financial participation of the Masonite Corporation of Chicago. Because of the special nature of the South African market, the new undertaking is designed to produce a great variety of building boards. Several features of unusual engineering interest are to be included in the large modern factory now in course of erection at Estcourt, Natal. It is to produce a wide range of Masonite products from wattle, providing Natal wattle interests with a valuable market for their waste products. Production using some 60,000 tons of wastewood was to start toward the end of 1948.

United Kingdom

Because a glut of Scandinavian pitprops is being cleared to the pulp factories, Scottish forest owners cannot sell their plantation thinnings for pitprops and pulping. From the forests of Moray, Nairn, Inverness, and Ross alone it is estimated that 50,000 tons of thinnings could be provided every year for pitprops and pulp. Thinning is costly, and forest owners will not carry out the job if their market is not guaranteed. One owner has had an order for 15,200 m (50,000 linear feet) of pit timber cancelled because of the glut of Scandinavian props, which the collieries, it is stated, are being forced to resell to the pulp factories.

United States of America

The new integrated divisions of the Weyerhaeuser Timber Co., Springfield, Oregon, are taking shape for operations next spring. The site accommodates a 590 m^3 (s) (250,000 board foot) double-band sawmill, a planing mill, a sulphate pulp mill, a 14,000 m^2 (150,000 square foot) fiber-box-board plant, three 220 m (720 foot) shipping sheds, a modern cafeteria to feed 200 persons, power plant, and office buildings. About 900 persons will eventually be employed. Logging in the 63,000-hectare (155,000-acre) holdings on the Middle Fork of the Wilamette River will be on an 80-year cycle.

Policy, Legislation, and Administration

Argentina

The Forestry Division, Ministry of Agriculture, in Argentina has been elevated to the status of Department of Forests (*Direccion General de Bosques*), following a recent decree.

Ceylon

The Conservator of Forests has announced that the policy adopted during the war years has been revised by the Minister of Lands and Agriculture. The revised policy is to co-ordinate forest operations with the requirements of indigenous flora and fauna. It aims to make the country self-supporting in timber (including fuel), both by the systematic exploitation of existing natural resources and by reforestation of selected areas. The plan is to conserve water supplies and prevent erosion, while at the same time providing for the export of such timber and forest produce as have a world market.

Italy

The Forestry Corps has been reorganized by a recent legislative decree laying down its responsibilities, which include: reforestation, forest and agricultural improvement in mountainous regions, technical and economic management of community property and property belonging to public institutions, fish and game control, compiling of statistics, conducting scientific forestry research work, etc. The Forestry Corps comprises 423 higher officials, 450 subaltern officers, and 5,073 forest guards and rangers. Administratively it is part of the Ministry of Agriculture and is headed by a director-general in the Ministry and by regional, departmental, and district inspectors in the field. Since the Higher Council on Agriculture and Forests has lost its former status, the functions of its forestry section are being performed by a Central Committee on Forestry which includes: the Director - General of Forests, three higher forestry officials, and four experts chosen from outside the Government.

U.S.S.R.

The Greater Volga project, aimed at improving navigation, developing electric power, maintaining the water level of the Caspian Sea, and bringing millions of acres of now dry land into cultivation has made a promising start. The general plan of development was worked out in 1933. Its realization will take many years. The first stage was building 128 kilometers of the Moscow-Volga Canal, which made Moscow a port of three seas. Three hydroelectric stations have been built on the upper reaches of the Volga. The reservoirs have improved navigation on the Upper Volga. Several other reservoirs constructed near Shcherbakov have made possible the regulation of the water on the Volga down to the mouth of the Kama River.

The next stage is the construction of the Gorki Power Plant. Work has already begun a short distance above the city of Gorki. The dam will be 13 kilometers long and will create a water level of 17 meters that will supply power to the Moscow, Gorki, Ivanovo, Yaroslavl, and Kostroma regions. Three more large hydroelectric stations are projected along the middle and lower reaches of the Volga—one near Kazan, another at Kuibyshev, and the third at Kamyshin. On the Kama River, one of the tributaries, four hydroelectric stations are to be constructed. One of them is already under construction at Molotov. The Kama power plants will supply electric current to the entire Ural a[illegible]. A hydroelectric station is also being built on the Oka River, another tributary of the Volga, in the vicinity of Kaluga. This will make it possible to link the Volga with the Dnieper through the Oka and Desna Rivers. The annual output of electric power is calculated at 55 billion kilowatt-hours. With completion of construction on the Volga-Don and the Kuma-Manich Canals, and with the linking of the Volga with a number of rivers—the Pechora and Vychegda through the Kama, with the Ob River through the Chusovaya and Iset Rivers, and with the Dnieper through the Oka and Desna Rivers—the Volga will become a great water-transport artery connected with all the seas that wash the shores of the European Soviet Union. Such an artery will especially benefit the timber industry, providing cheap transportation for timber coming from the vast forests of the Pechora region in the north to the regions of the south and the west where wood-using industries can be established.

The land-improvement program of the Greater Volga project is confined to the territory along the middle and lower stretches of the Volga. This territory is often subject to droughts because of the proximity of the Kizil-Kum and Kara-Kum deserts; dry winds from these deserts cause frequent crop failures in this region. Water for irrigation is to be taken through a network of canals from the vast reservoirs built along the Volga River. Numerous forest strips will afford further protection against the hazards of weather, making agricultural production more dependable.

The implementation of a 15-year plan for achieving maximum production of a vast area of the U.S.S.R. through reclamation and development work has been announced through the press and radio by the Soviet Government. The gigantic program is to cover nearly 120 million hectares and 80,000 collective farms. A specially created government agency will be responsible for its execution and for the co-ordination of the activities of the Ministries of Agriculture and Forestry of the Republics of the Soviet Union with those of research stations and industries. The objective is to alter and improve geographic and climatic conditions on a vast area of the globe. It will ensure the protection of the rich wheat lands of the Volga Basin, of the North Caucasus, of the Eastern Ukraine, and of Central Russia against drought and erosion, particularly wind erosion—a persistent menace which reduces productivity by destroying the very substance of the land. The forest, as natural protector of the soil and regulator of water flow and climate, is the keystone of the Soviet plan.

Forests are to be used especially as protection against the dry winds from the southeast, in the form of vast shelterbelts covering 6 million hectares. They will comprise eight main belts of varying width extending over 5,000 kilometers and will bar the way to these winds on carefully chosen stretches. The longest will stretch more than 1,100 kilometers from the

southern foothills of the Urals to Gurev, at the mouth of the Ural River on the Caspian Sea. Another system comprising two parallel belts each about 100 meters wide will follow the Volga from Saratov to Astrakan and will be backed on the opposite bank by another belt running from Kamyshin to Stalingrad. Besides these main belts, minor shelterbelts will constitute a field-by-field defense system on all the collective farms in the area covered by the plan.

With the shelter thus provided, it will become possible to go ahead on the agricultural development plan. Forty-five thousand ponds and artificial lakes are to be created, their water supply assured by planned forestation work. They will be used for irrigation purposes and to generate electric power. A modern crop rotation plan is envisaged, once the shelter is established.

Meetings

International Labour Organisation

The International Labour Organization's Permanent Commission on Migration has met twice, once in August 1946 in Montreal, and again from 23 February to 2 March 1948, at Geneva. These meetings were for the purpose of establishing a basis for an International Convention for the Protection of Migratory Labor, which would revise the 1939 Convention, or rather adapt it, to present-day conditions.

Although the 1939 Convention firmly established the protection of migratory labor, it made no reference to the setting of technical and professional standards for the selection of migratory labor, which would entail a uniformity in describing professions and professional qualifications. The Commission has given a great deal of attention to this matter. At the same time it drafted a standard agreement between countries regulating both migration and immigration. This document was inspired to a large extent by the Franco-Italian Agreements now in force. It provides for the protection of workers by means of a bilateral technical Commission divided into two subcommissions, one to be located in the country of emigration which would deal with the problems of selection and recruitment; and the other, located in the country of immigration, to be entrusted with the establishment of suitable criteria so as to eliminate all difficulties in the employment of immigrant labor. The Commission further studied methods of co operating with the other specialized agencies of the United Nations.

Since labor shortage is one of the principal obstacles to the development of unexploited forests and, in some countries, even hampers the increase in yield from productive forests, the use of migratory labor, either on a temporary or permanent basis, is important to forestry.

International Woodworkers Association

The International Woodworkers Association of America at its Convention held in Portland, Oregon, 11 to 15 October 1948, adopted resolutions on forest conservation, fire protection, reforestation, and private forestry:

On the subject of forest conservation, it resolved that "the most urgent need in forest conservation is to put the existing timber stands under scientific forest management whereby overcrowded and overmature trees are removed, healthy trees are left to grow, watershed and recreational values are protected, and wildlife values are increased"; and to carry this out, they recommended:

"(1) adequate government appropriation for the development of logging roads and technical forestry plans for government-owned timber;

"(2) a carefully developed program of incentives to all private forest owners and logging operators to practice good forestry in the management of privately owned timber."

With regard to forest fire protection and reforestation, the Convention restated its support for forest fire protection and reforestation but condemned "the failure of the dominant propaganda groups of the wood industry to . . . support a program that would stop the destruction and high-grading of forests by reckless and indiscriminate use of the ax" and asked for a program which, "by means of proper road development and scientific forest management, would save the huge amounts of valuable timber which today are permitted to die and rot to waste in unmanaged forests."

On the subject of wood utilization, the Convention urged the development of a system of integrated logging and utilization of forest and mill waste by various branches of the wood industry with the co-operation of labor, management, and government conservation agencies, but it opposed monopolistic means of achieving such integration.

On the subject of subsidies for private forestry, the Convention urged the government to develop a program of assistance patterned after the National Farm Program to include low-cost credit, conservation payments, technical assistance and increased research, including appropriate payments to any forest owner who will place a permanent restriction on the title to his forest to provide that such forest must be managed as a permanent forest under technical forestry supervision unless subsequently reclassified for nonforest use by appropriate public authorities.

Book Reviews

Annual Report of the Forest Service, Province of British Columbia, 1947.

The 1947 Report of the Chief Forester, Canadian Province of British Columbia, covers a year of great activity. The total value of production of the forest industries of the province amounted to $282 million as compared with $173 million in 1946. The volume of timber felled increased by more than 30 percent over the cut of the previous year. Air and ground inventory surveys were completed on more than 810,000 hectares (2 million acres). Although reforestation was hampered by shortages of labor and supplies, nearly 4 million trees were planted on 1,980 hectares (4,890 acres) during the year. Weather was good from the standpoint of forest fire protection and the number of fires was substantially below the ten-year average. At its 1947 session the legislature adopted an amendment to the Forest Act providing for the creation of forest management license areas, with the object of facilitating the practice of sustained-yield management of forest resources by the forest industries. This legislation is considered to be of outstanding importance to the development and perpetuation of the province's forest resources.

Report of the FAO Mission for Siam. Washington, U.S.A., September 1948. Pp. 125, $1.50.*

The FAO Mission for Siam reported on agricultural production, irrigation, control of rinderpest, forestry, economics of agriculture, agricultural statistics, and agricultural services.

The forestry section was prepared by G. N. Danhof of the Forest Service of Indonesia. In it he makes 30 recommendations covering long-range policy, support for forestry, autonomy for the Forest Department, increase of technical staff, an air survey and inventory of forests, increased reservation of forests, adoption of sustained-yield management, stricter enforcement of forest laws, closer control of concessions in the public interest, more efficient business organization of the Forestry Industrial Organization, various measures for improving measurement and sale of timber, setting up an improvement fee from sale of timber available for forestry work, a program of planting and natural regeneration, freeing the Forest Department from handling tree crops such as rubber and quinine, measures for forest protection, consultation with the Forestry Department on setting aside forests for agricultural use, prolonging the periods of bush fallow, strengthening research and the arboretum, and measures for improving technical education.

*Copies are obtainable from accredited FAO sales agents and distributors; see page 289.

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THE Nations accepting this Constitution, being determined to promote the common welfare by furthering separate and collective action on their part for the purposes of

raising levels of nutrition and standards of living of the peoples under their respective jurisdictions,

securing improvements in the efficiency of the production and distribution of all food and agricultural products,

bettering the condition of rural populations,

and thus contributing toward an expanding world economy,

hereby establish the Food and Agriculture Organization of the United Nations . . . through which the Members will report to one another on the measures taken and the progress achieved in the fields of action set forth above.

—*Preamble to the Constitution of the Food and Agriculture Organization of the United Nations*

FAO Member Nations

Australia
Austria
Belgium
Bolivia
Brazil
Burma
Canada
Ceylon
Chile
China
Colombia
Costa Rica
Cuba
Czechoslovakia
Denmark
Dominican Republic
Ecuador
Egypt
Ethiopia
El Salvador
Finland
France
Greece
Guatemala
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Iraq
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Peru
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Saudi Arabia
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